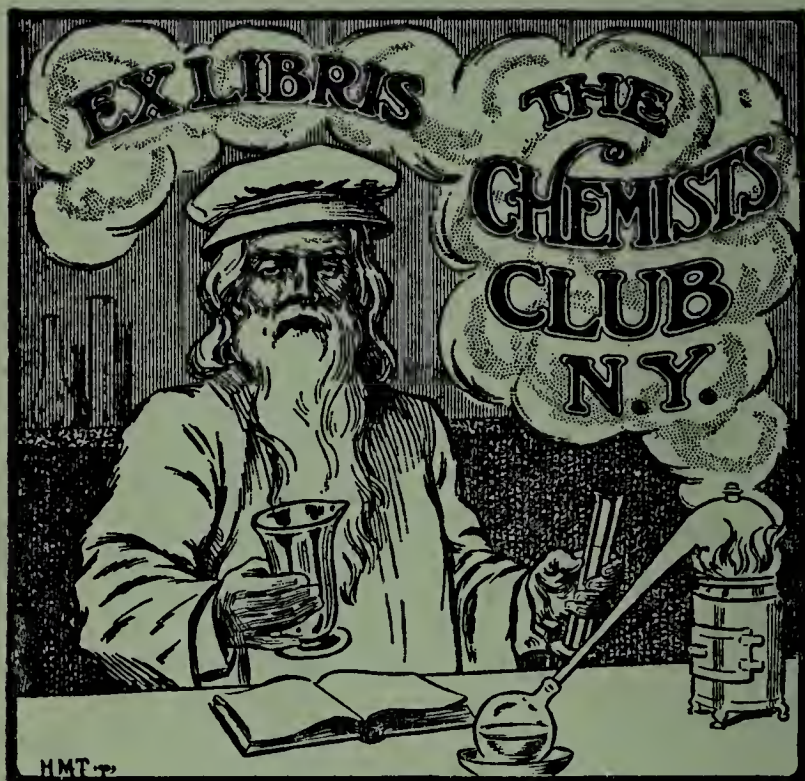




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CHEMICAL HANDICRAFT:

A

CLASSIFIED AND DESCRIPTIVE CATALOGUE

OF

Chemical Apparatus,

SUITABLE

FOR THE PERFORMANCE OF CLASS EXPERIMENTS,

FOR EVERY PROCESS OF CHEMICAL RESEARCH,

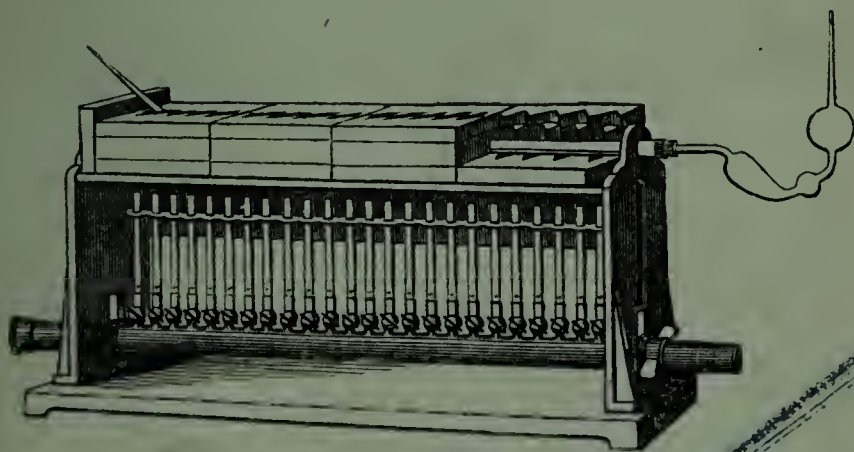
AND FOR CHEMICAL TESTING IN THE ARTS.

Accompanied by Copious Notes,

Explanatory of the Construction and Use of the Apparatus.

By JOHN JOSEPH GRIFFIN, F.C.S.

Illustrated by upwards of Fifteen Hundred Engravings on Wood.



LONDON:

JOHN J. GRIFFIN AND SONS,

CHEMICAL AND PHILOSOPHICAL INSTRUMENT MAKERS,

22, GARRICK STREET, COVENT GARDEN.

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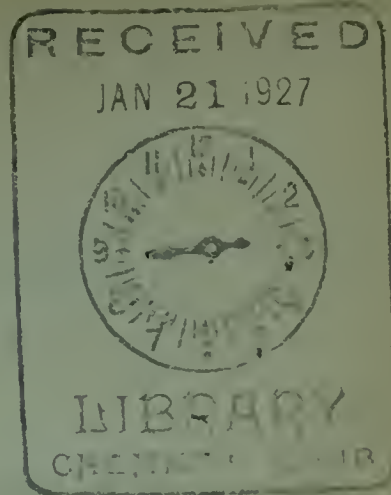
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PREFACE.

THE following work is, in the main, a PRICE CURRENT OF CHEMICAL APPARATUS. But a slight examination of it will show that it is something more than that. If, indeed, its commercial character were separable, the residue of the work might fairly be considered *a Report on the Apparatus which the philosophical chemist has at present at command, to aid his original researches, or to demonstrate the truths adduced in his teachings*. In fact, much of the work is of the nature of a treatise on what is termed *Chemical Manipulation*. The materials for it have been collected from all parts of Europe, with much cost and labour; and considerable time has been spent in trying the instruments one against another, and in making modifications and improvements. Under the heads of *Air Pumps, Lamps, Furnaces, Gas Burners, Blast Furnaces, Blowpipe Apparatus, Volumetric Analysis*, and in many other places, the reader will find the results of numerous original experiments of the above character. By a careful classification of the apparatus, and by the use of abundant figures and short descriptive notes, a considerable mass of information on practical points has been condensed into the work. Of the 1500 figures that illustrate it, more than 600 have been drawn from the instruments expressly for this Edition. It is hoped that, such as it is, the work will prove useful to all who have occasion to make Chemical Experiments.

JOHN J. GRIFFIN.

2, GARRICK STREET, COVENT GARDEN, W.C.

London, January, 1866.

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Scientific Handicraft.

PROSPECTUS.

It is the intention of the Editor of this work to publish a series of works on the same plan as CHEMICAL HANDICRAFT, but relating to Apparatus suitable for the Experimental Illustration of Elementary Instruction in the following Sciences :—

MECHANICS,
HYDROSTATICS,
PNEUMATICS,

ACOUSTICS,
HEAT,
LIGHT,

ELECTRICITY,
GALVANISM,
MAGNETISM.

The series will be published under the general title of SCIENTIFIC HANDICRAFT. Each work will be abundantly supplied with illustrative engravings, and contain detailed instructions for the effective use of the instruments.

Apparatus for Mechanical Operations.

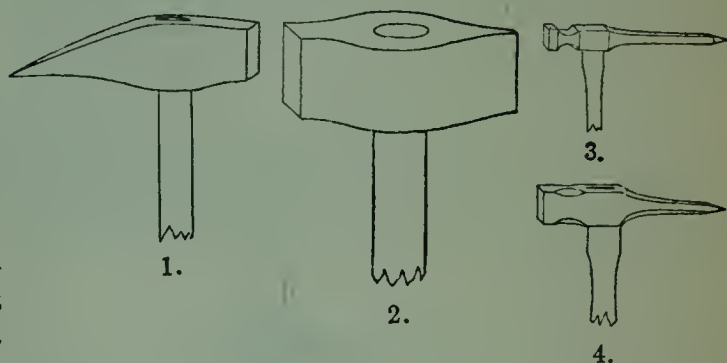
HAMMERS.

A.—HAMMERS FOR GEOLOGISTS.

Best Sheffield make, with stout, tough handles.

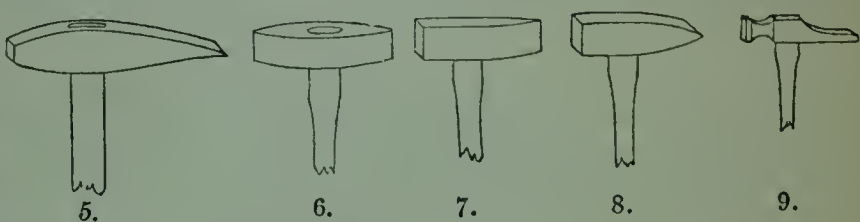
Figs. 1 and 2 represent heavy hammers for hewing hard rocks. Figs. 3 and 4 represent picks for extracting fossils from soft rocks.

1. Geological Hammer, head 8 by 2 inches, one face $1\frac{1}{2}$ inch square, and a pick at the other end, weight about 5 lbs.—handle 3 ft. long, 6s.
2. Geological Hammer, head 6 by $2\frac{1}{2}$ inches, one face 1 by $2\frac{1}{4}$ inches, and another face $\frac{1}{3}$ by $2\frac{1}{4}$ inches, weight about 5 lbs.—handle 3 feet long, 7s.
3. Small Pick, head 7 inches long, flat square face, $\frac{7}{10}$ inch square, and sharp point at the other end, 2s.
4. Large Pick, head 7 inches long, flat square face 1 inch square, sharp pick at the other end, 3s. 6d.



B.—HAMMERS FOR MINERALOGISTS (for Trimming Specimens, &c.).

5. Trimming Hammer, head $5\frac{1}{2}$ by 1 inch, one face $\frac{1}{2}$ inch square, with hard and sharp cutting edge, at right angles to the handle—length of handle 18 inches, 2s. 6d.
6. Trimming Hammer, head $3\frac{1}{2}$ inches long, with two cutting edges parallel to the handle, 2s.
7. Ditto, head $3\frac{1}{2}$ inches long, flat face 1 inch square, and cutting edge parallel to the handle, 2s.
8. Ditto, same as No. 7, but the cutting edge at right angles to the handle, 2s.
9. Blowpipe Hammer, head $2\frac{1}{2}$ inch, flat square face $\frac{1}{2}$ inch square, cutting edge at right angles to the handle, 1s. 6d.

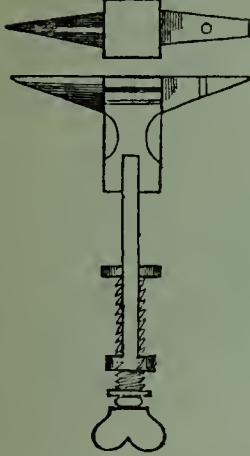
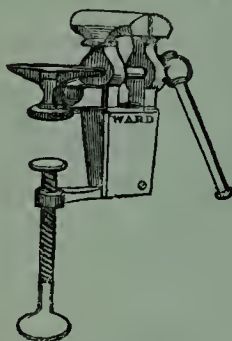


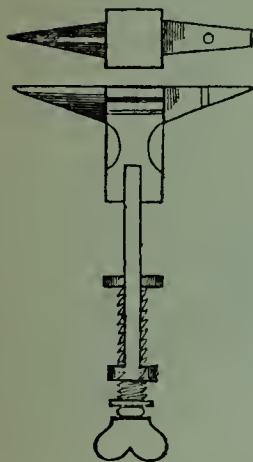
C.—HAMMERS FOR ASSAYERS.

10. Hammer for flattening buttons of silver for silver assays, small size, 2s. 6d.; large size, 3s.
11. Heavy hammer for flattening gold for gold assays, about 6 lb. weight, bright face, 6s.
12. Square-faced hammer for breaking a crucible after a fusion, 2s.

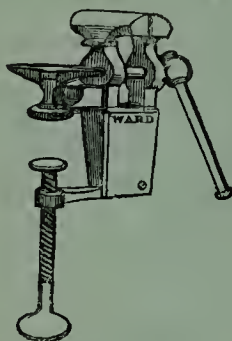
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POLISHED SLABS OF HARDENED STEEL, WELDED ON IRON BLOCKS.

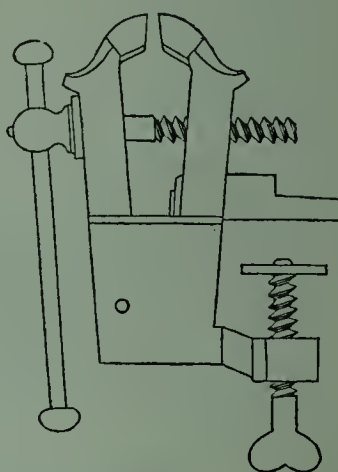
13. Anvil for blowpipe experiments, surface $1\frac{1}{2}$ by $1\frac{1}{2}$ inch, block $\frac{5}{8}$ inch thick, Fig. 13, 1s. 6d.  13.
14. Anvil for blowpipe experiments, surface 2 by 2 inches, block $\frac{7}{8}$ inch thick, Fig. 13, 2s. 6d.  14.
15. Anvil for blowpipe experiments, and for flattening heavier beads of metal than those afforded by blowpipe experiments, surface 2 by 2 inches, block 2 inches thick, Fig. 15, 6s.  15.
16. Stake or Anvil for assayers, used for flattening large beads of gold and silver, form of Fig. 16, surface $3\frac{1}{2}$ by $3\frac{1}{2}$ inches, block 3 inches thick, fang 3 by 2 inches, 16s.  16.
17. Stake, mounted on a solid block of hard wood, 5 inches in the cube, 19s.  17.
18. Anvil, adapted to screw to a table, for the repair of small apparatus, for bending and coiling wires, or slips of metal, &c., Fig. 18, 4s.  18.



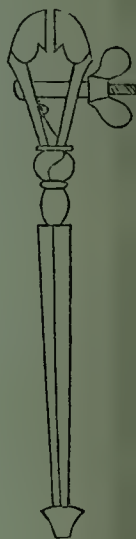
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19.



20.



21.

VICES.

Useful in the Construction or Repair of Apparatus.

19. Vice and Anvil combined, to screw to a table, Fig. 19, 8s.
20. Vice to screw to a table, Fig. 20, 5s.
21. Vice (Watchmaker's) to hold small articles steadily in the hand, Fig. 21, 3s. 6d.
22. Bench Vice, powerful, 4-in. faces, weight 36 lbs., 30s.

Adapted for use in conjunction with the Lathe No. 23.

23. LATHE, suitable for the Manufacture and Repair of most articles of Chemical and Physical Apparatus, £20.

Description.—Foot-Lathe, with a 3-ft. planed iron bed and standards, 5-in. centre, mandril head and cylinder poppet, iron treadle and wood bench, 7-inch gun-metal pulley, 26½-inch turned for motion wheel, two catgut bands with steel hooks, 9½-inch surface chuck, 4 wrought-iron chuck, 1 centre chuck, 1 reel, and 2 ties.

24. COLLECTION OF CHUCKS AND TURNING TOOLS for the Lathe, £5 to £10.
25. Set of Instruments for cutting $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ -inch Wooden Screws, consisting of three iron tools and three wooden screw blocks (as described in Williams' "Chemical Manipulation"), 15s.
26. FLATTING MILL, or Steel Rollers, for rolling metals into sheets, used in particular for flattening alloys of gold and silver, in preparation for the operation of parting, 3-inch rollers, £7.
27. Press for making Potassium and similar soft metals into wires, in case, 10s.

TOOL CHESTS.

The tools contained in these chests are all of the best Sheffield make, with neat handles. The boxes are of oak. The general style is shown by figure 33.

28. No. A, price 8s.

Contains Handsaw, Hammer, Mallet, Bradawl, Gimlet, Chisel, Gouge, Turnserew.

29. No. B, price 9s. 6d.

Contains Handsaw, Hammer, Mallet, Two Gimlets, Two Bradawls, Chisel, Gouge, Turnserew.

30. No. C, price 13s.

Contains Handsaw, Hammer, Mallet, Pineers, Bradawl, Gimlet, Chisel, Gouge, Turnserew, Rule, Marking Awl, Punch.

31. No. O, price 20s.

Contains Handsaw, Hammer, Mallet, Rule, Pincers, Two Gimlets, Two Bradawls, Chisel, Gouge, File, Marking Awl, Punch, Turnserew, Square, Compasses, Taeks, Brads, and Screws.

32. No. 2, price 35s.

Contains Handsaw, Hatchet, Hammer, Mallet, Rule, Pineers, Three Gimlets, Three Bradawls, Two Chisels, One Gouge, Three Files, Oil Stone, Marking Awl, Punch, Turnserew, Spokeshave, Square, Cold Chisel, Pliers, Compasses, Taeks, Brads, and Screws.

33. No. 4, price 50s.

Contains Handsaw, Hatchet, Hammer, Mallet, Rule, Pineers, Four Gimlets, Four Bradawls, Four Chisels, Two Gouges, Three Files, Oil Stone, Marking Awl, Punch, Two Turnserews, Spokeshave, Square, Claw-Wrench, Pliers, Compasses, Lock-Saw, Plane, Marking Gauge, Glue-Pot and Brush, Taeks, Brads, and Screws.

34. No. 6, price £4.

Contains Two Saws, Hatchet, Two Hammers, Mallet, Rule, Pineers, Six Gimlets, Six Bradawls, Six Chisels, Four Gouges, Four Files, Oil Stone, Marking Awl, Two Punches, Three Turnserews, Two Spokeshaves, Square, Chisel for cold metal, Pliers, Compasses, Lock-Saw, Smooth Plane, Jack Plane, Marking Gauge, Glue Pot and Brush, Drawing Knife, Cutting Punch, Scraper, Bevil, Taeks, Brads, and Screws.

35. No. 8, price £5 5s.

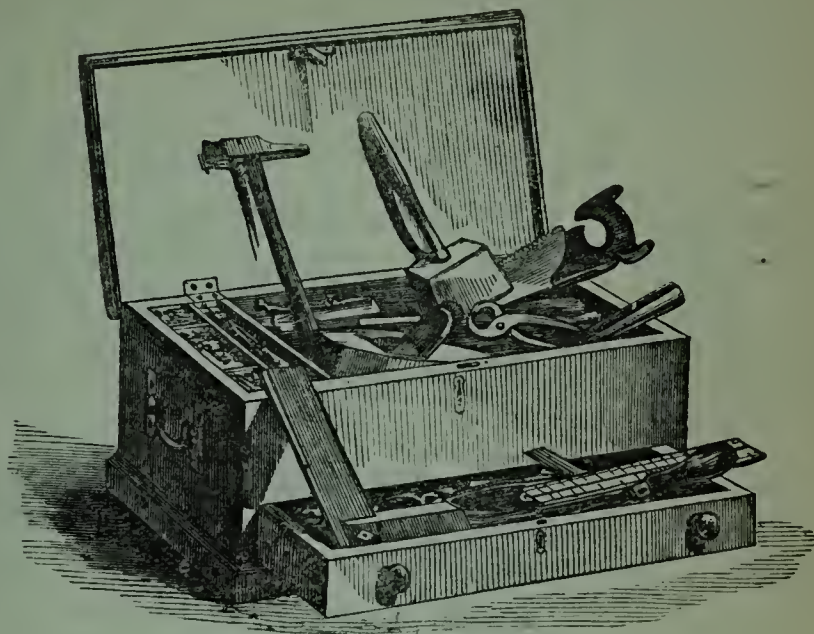
Contains Three Saws, Axe, Two Hammers, Mallet, Rule, Pineers, Six Gimlets, Six Bradawls, Six Chisels, Four Gouges, Four Files, Oil Stone, Marking Awl, Three Punches, Three Turnserews, Red-Key, Hand-Vice, Two Spokeshaves, Square, Claw-Wrench, Two Pair Pliers, Compasses, Lock-Saw, Smooth Plane, Jack Plane, Three Gauges, Glue Pot and Brush, Drawing Knife, Cutting Punch, Scraper, Bevil, Chalk Line Reel, Taeks, Brads, and Screws.

36. Horticultural Tool Chest, £3 10s.

Contains Garden Hoe, Dutch Hoe, Triangular Hoe, Spud, Weeding Hook, Garden Rake, Garden Shears, Improved Slide Pruning Shears, Sliding Pruning Scissors, Flower Gatherer, Vine Scissors, Pruning Saw, Garden Trowel, Garden Hammer, Garden Reel, Pruning Knife with stag handle, Budding Knife with ivory handle. All the tools requiring it are made to screw into a socket attached to a hard-wood handle; the whole enclosed in a strong oak box, with lock, key, and handles.

37. Colonial Tool Chest, £8 8s.

Contains Canadian Adze, Carpenter's Adze, Pickaxe, Carpenter's Handsaw, Carpenter's Tenon Saw, Carpenter's Compass Saw, Jack Plane, Smooth Plane, One Pair Grooving Plane, Rabbet Plane,

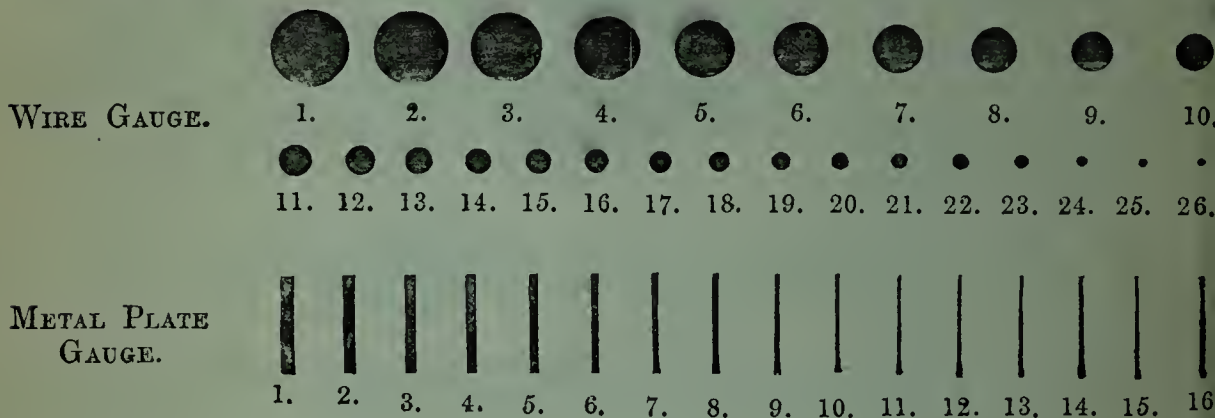


33.

Five Firmer Chisels, Three Gouges, Three Mortise Chisels, Three Socket Chisels, Plated Square Improved Auger Pad, Three Augers, Spokeshave, Two Turnscrews, Marking Gauge, Brass Slid Mortise Gauge, best Brace with Eighteen assorted Bits, Bench and Roofing Hammer, Three Files Six Gimlets, Six Bradawls, Carpenter's Mallet, Boxed Whetstone, Marking Awl, Brad Punch, Compasses, Carpenter's Pincers, Glue Pot and Brush, Pliers, and Chalk Line Reel; the whole enclosed in a strong deal box, 30 inches long, 16 inches wide, 17 inches deep, fitted with drawers and partitions, lock, key, and pair of handles.

WIRE and METAL-PLATE GAUGES.

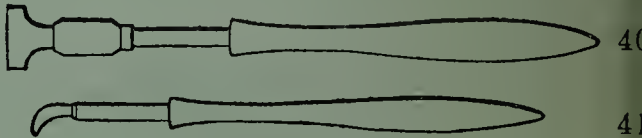
38. In sending orders for Platinum Wires, Platinum Plates, Copper Wires, for galvanic purposes, &c., and in specifying the *thickness desired* for Metallic Articles formed of Wires or Plates, such as Capsules, Crucibles, &c., Customers are requested to state their wishes by reference to the following figures, which show, as nearly as can be done in print, the thicknesses of the Copper and Platinum Wires, and the sheets of Platinum, that are commonly kept in stock:—



39. AGATE BURNISHERS,—finely polished, not mounted; all the patterns, Nos. 1 to 9, at 1s. each.

Agate Burnishers of the foregoing patterns mounted on polished Rosewood or Mahogany handles, with Brass fittings, as follows:—

40. Similar to Nos. 4, 7, 8, 9, fig. 39, mounted in the style of fig. 40, 6s. each.
41. Similar to Nos. 1, 2, 3, 5, 6, fig. 39, mounted in the style of fig. 41, 3s. 6d. each.
42. Steel Burnishers, finely polished, many patterns, mounted on wooden handles 1s. 6d. to 3s. 6d. each.
43. Agate Caps for mounting Compass Needles and other instruments that turn on steel points, finely polished, 3-16 inch diameter, 1s. each.



MORTARS and PESTLES.

Every Mortar in the following list is furnished with a Pestle at the price quoted; and in all cases the Pestle is in one piece, not mounted on wood, unless specially so stated.

I. CAST-IRON AND STEEL MORTARS.

44. Cast-Iron Mortars, vase form, Fig. 44, not polished.

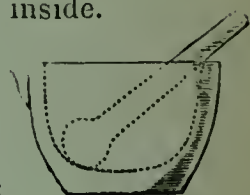
No.	Diameter.	Price.	No.	Diameter.	Price.
1	5 inch.	2s.	5	10 inch.	9s.
2	6 inch.	4s.	6	11 inch.	14s.
3	8 inch.	5s.	7	12 inch.	18s.
4	9 inch.	7s.			



44.

45. Cast-Iron Mortars, bowl-shaped, Fig. 45, turned and polished inside.

No.	Diameter.	Price.	No.	Diameter.	Price.
1	4 inch.	2s.	4	6½	4s. 6d.
2	5 inch.	3s.	5	7	5s. 6d.
3	5½ inch.	4s.	6	7½	6s. 6d.



45

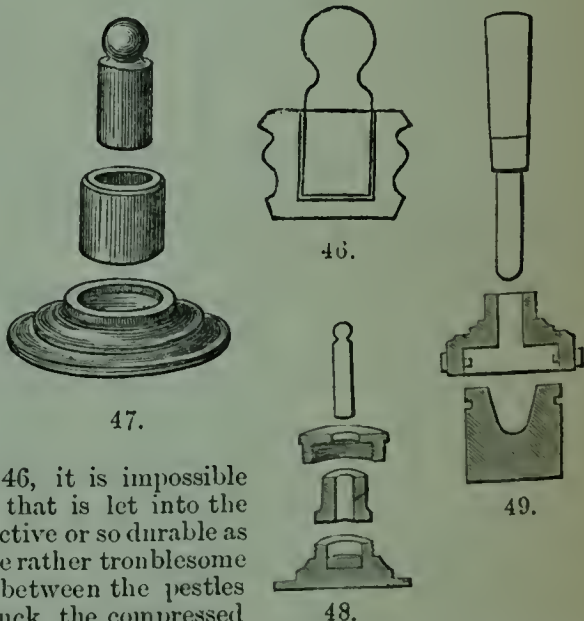
STEEL CRUSHING MORTARS, or Diamond Mortars, for pounding hard Minerals for Analysis, previously to grinding them in Agate Mortars,—all made of hardened steel:—

46. Mortar and Pestle, in two pieces, Fig. 46, bore ¾ inch, 6s.

47. Mortar and Pestle, bore ⅝ inch, Fig. 47 or 48, each, 14s.

48. Mortar and Pestle, bore 1½ inch, Fig. 47 or 48, each, 25s.

49. Mortar and Pestle, in three pieces, Fig. 49, with long pestle, 27s.



47.

46.

48.

49.

Owing to the shape of the smallest mortar, No. 46, it is impossible to make the bottom of it so hard as the steel plate that is let into the bottom piece of No. 47. It is not, therefore, so effective or so durable as the other mortars. The pestles of Nos. 46 and 47 are rather troublesome to work, in consequence of there being no air-way between the pestles and the mortars. When the pestle of No. 47 is struck, the compressed air forces the cylinder to rise, and some of the powder is blown away. To remedy this defect, the mortar Fig. 48 is made with a screw, which fixes down the cylinder to the base, and prevents the escape of powder. All these instruments are worked by striking the short, flat-bottomed pestle with a hammer, after putting the mineral into the cylinder of the mortar,—and the pulverization is a rather slow operation.

The largest of these mortars, No. 49, is constructed upon a different principle. The interior of the mortar is spherical, like that of an ordinary porcelain mortar, so that the substance to be pounded falls back to the bottom after every stroke of the pestle. The top or cover of the mortar is fastened on by two bayonet catches, and is easily put on and off. The pestle is heavy, and large enough to be grasped by the hand and used to pound the mineral without the help of a hammer. Owing to the air-way between the pestle and mortar, and the protection of the horizontal cover, much less of the powder is blown out than usually happens with poundings in the other mortars. The required pulverization of a mineral is, for these reasons, rapidly and easily effected in a mortar of this construction. The bottom of the mortar, turned upside down, can be used as a blowpipe anvil.

II. AGATE PESTLES AND MORTARS, for the fine pulverization of Siliceous and other hard Minerals. Best quality, sound pebbles, well polished; form of Figure 50.

The sizes stated are the Diameters of the Mortars.

50.—A. SMALL MORTARS, SUITABLE FOR EXPERIMENTS WITH THE BLOWPIPE.

1 inch, 2s. 6d.	1½ inch, 4s. 6d.	2 inch, 7s.
1¼ inch, 3s. 6d.	1¾ inch, 5s. 6d.	2¼ inch, 8s. 6d.



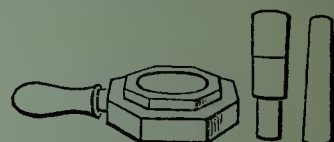
50.

51.—B. LARGE MORTARS FOR PULVERIZING MINERALS FOR ANALYSIS.

2½ inches, 12s.	3½ inches, 28s.	4½ inches, 48s.	5½ inches, 80s.
2¾ inches, 15s.	3¾ inches, 33s.	4¾ inches, 52s.	5¾ inches, 88s.
3 inches, 18s.	4 inches, 38s.	5 inches, 63s.	6 inches, 95s.
3¼ inches, 21s.	4¼ inches, 42s.	5¼ inches, 70s.	

52. C.—MOUNTED AGATE MORTARS. Figure 52.

To facilitate the pulverization of hard substances when required in quantity, which is a laborious operation when the pestle is short or small, I have mounted some agate mortars and pestles in the manner shown by Figure 52, *a* and *b*. The former represents an Agate Mortar sunk in a solid block of mahogany, and provided with a handle, by which the mortar can be held securely with one hand while the other makes use of the pestle. Figure 52 *b* represents the Pestle, which consists of an agate pestle of the usual form, fastened to a long boxwood handle by means of a collar of polished iron; the total length of this combination being about six inches. The prices of Mortars and Pestles thus mounted are as follows:—



52, a, b. c.

4 inch Mortar, 47s.	5 inch Mortar, 76s.	5¾ inch Mortar, 105s.
4½ inch Mortar, 58s.	5¼ inch Mortar, 84s.	6 inch Mortar, 115s.

53. D.—MOUNTED AGATE PESTLES.

Any of the Mortars under No. 51 (B) can be furnished with Mounted Pestles like Figure 52 *b*, at 4s. 6d. extra.

54. E.—LONG AGATE PESTLES, IN ONE PIECE.

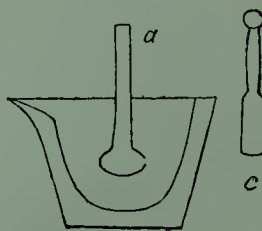
These consist of solid blocks of agate, cut into long cylinders like Figure 52 *c*, and polished at both ends. Price, without Mortars, as follows:—

- No. 1. 6 inches long, 1 inch to 1½ inch diameter, 8s.
2. 5 inches long, ¾ inch diameter, 7s. 6d.
3. 4 inches long, ⅝ to ¾ inch diameter, 6s.

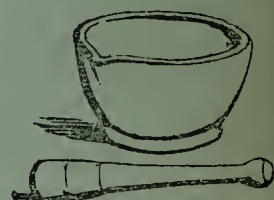
III. PORCELAIN MORTARS.

55. BERLIN PORCELAIN MORTARS, biscuit within, glazed outside, the pestles in one piece.

No. 0, 2 in. dia., 8d.	No. 2, 4½ in. dia., 2s. 6d.
1, 3½ in. dia., 2s.	3, 5 in. dia., 3s. 3d.

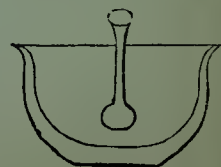


55. No. 0.



55 Nos. 1, 2, 3.

56. Berlin Porcelain Blowpipe Mortar, 1½ inch diameter, glazed within, a cheap but inferior substitute for an agate mortar in blowpipe experiments, with pestle, Fig. 56 and Fig. 68, No. 4, 6d.



56.

57. Berlin Porcelain Apothecaries' Mortars, for grinding and mixing powders, shape broad and shallow, without spout, with a rim to prevent the powder being thrown out; the pestles with broad ends and in one piece. They may be had either glazed or biscuit within, form of No. 1, Fig. 68.

No. 1, $5\frac{1}{2}$ inches diameter, 3s.
2, $7\frac{1}{2}$ inches diameter. 5s.

No. 3, 9 inches diameter, 6s.

THURINGIAN PORCELAIN MORTARS, thick in the body, with large spouts, glazed outside, biscuit inside, all with PESTLES, *four kinds*, Nos. 58 to 61.

58. Form shallow and wide, resembling fig. 58, but with spout.

No. 3, $4\frac{3}{4}$ inches wide, 10 ounces, 2s. 6d.
1, 6 " " 18 " 3s. 6d.
00, $7\frac{1}{2}$ " " 36 " 4s. 6d.

59. Form hemispherical, with large spout and foot, Fig. 59.

No. 8, 5 inches wide, 18 ounces, 2s. 6d.
5, $7\frac{1}{4}$ " " 50 " 5s. 6d.

60. Form, conical, Fig. 60.

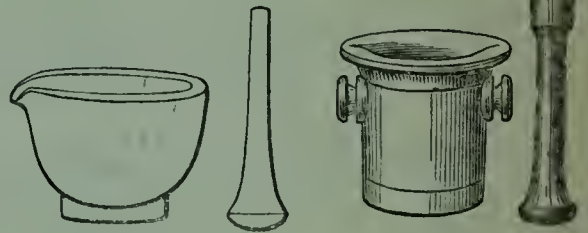
No. 3, 4 inches wide, 8 ounces, 1s. 8d.
1, 5 " " 18 " 2s. 9d.
00, $6\frac{1}{2}$ " " 32 " 4s. 6d.

61. Deep and Stout Mortar, for mixing mercurial ointments, &c., with handles, without spout, form of Fig. 61.



58.

60.



59.

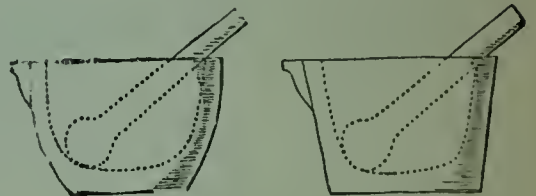
61.

No. 0, 7 inches high, $7\frac{1}{2}$ inches wide, contents 30 ounces, 9s.

1, $5\frac{1}{2}$ inches high, 6 inches wide, contents 20 ounces, 4s. 6d.

62. BERLIN SEMI-PORCELAIN MORTARS, deep form, with spout, glazed outside, biscuit within.

The hemispherical form, Fig. 62 A, and the conical form, Fig. 62 B, are the same in price.



62 A.

62 B.

No. 00, $2\frac{1}{4}$ inch diameter, 5d.
0, $2\frac{1}{2}$ " " 7d.
1, $3\frac{1}{4}$ " " 9d.
2, 4 " " 1s.
3, 5 " " 1s. 6d.

No. 4, 6 inch diameter, 2s.
5, $6\frac{3}{4}$ " " 2s. 6d.
6, $7\frac{3}{4}$ " " 3s.
7, $9\frac{1}{4}$ " " 4s. 6d.

63. Berlin Semi-Porcelain Mortars, shallow and wide form, Fig. 63, but with spout like Fig. 64, glazed outside, biscuit inside.



63.

No. 2, $3\frac{3}{4}$ inch diameter, 1s. 2d.
3, 5 " " 1s. 6d.
6, $6\frac{1}{4}$ " " 2s.

No. 9, $8\frac{1}{2}$ inch diameter, 3s. 6d.
11, $9\frac{1}{2}$ " " 4s. 3d.
12, $10\frac{1}{4}$ " " 5s.

64. MORTAR FOR USE IN ORGANIC ANALYSIS, for mixing powders; broad and flat, with spout, glazed inside, with glazed pestle, Berlin semi-porcelain, Fig. 64.

No. 3, $4\frac{1}{4}$ inches diameter, 2s.

4, 5 „ „ 2s. 3d.

64.



65. Mortars for use in Organic Analysis, for mixing powders, broad and flat, glazed inside, glazed pestle, Dresden porcelain, with sharp spout, Fig. 64.

No. 6, 5 inches diameter, contains 10 ounces of water, 3s. 6d.

7, 4 „ „ „ 5 „ „ 2s. 9d.

IV. GLASS MORTARS.

66. HARD BOHEMIAN GLASS MORTARS, broad flat form, very stout, with spouts and strong pestles, Fig. 68, No. 6.

$2\frac{1}{4}$ inch, $1\frac{1}{2}$ oz. 8d.

$3\frac{1}{4}$ inch, 4 oz. 10d.

$4\frac{1}{4}$ inch, 10 oz. 1s. 0d.

$5\frac{1}{4}$ inch, 20 oz. 1s. 4d.

$6\frac{1}{2}$ inch, 30 oz. 1s. 8d.

$7\frac{1}{4}$ inch, 50 oz. 2s. 6d.

$8\frac{1}{4}$ inch, 70 oz. 3s. 6d.

V. SERPENTINE MORTARS.

67. Mortars of Serpentine, broad and flat, with sharp spouts, for mixing soft powders with water, &c., highly polished.

$4\frac{1}{2}$ inch 1s. 3d.

$5\frac{1}{2}$ inch 1s. 6d.

$6\frac{1}{2}$ inch 2s. 6d.



68.

68. REFERENCES.—The Mortars figured in this group represent the articles numbered as follows:—

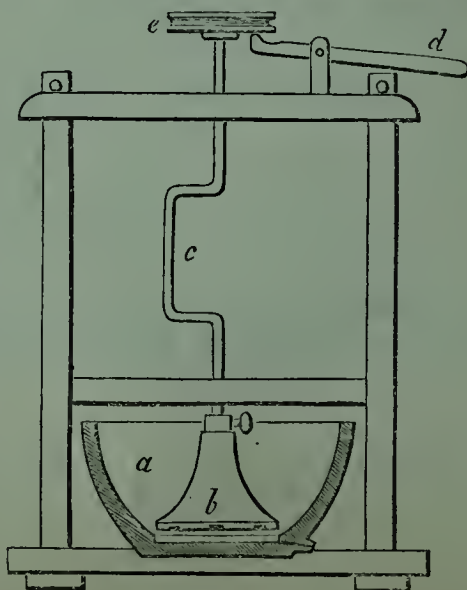
Figure	1.	2.	3.	4.	5.	6.	7.	8.	9.
No.	57.	55.	55.	56.	59.	66.	47.	46.	50.

69. PORCELAIN LEVIGATING MACHINE, Fig. 69.

No. 0, 18 inch Mortar . . 42s.

3, $10\frac{1}{2}$ inch Mortar . . 28s.

This apparatus consists of a Thuringian Porcelain Mortar, *a*, Fig. 69, with a flat-bottomed grooved pestle, *b*. This is attached to an iron crank, *c*, which is mounted in a strong wooden frame. If the crank is turned by the hand applied at *c*, or by a band passing round *e*, the pestle rotates and levigates the substance in the mortar. There is a spout at the bottom of the mortar for running off the mixture when sufficiently ground.



69.



70.

71.

SIEVES.—SIFTING APPARATUS.

70. Flat Sieve, for separating small stones, grit, sand,

and fine sand, in the Mechanical Analysis of Soils; consisting of two short japanned metallic cylinders, united by a bayonet catch, with three moveable bottoms of metallic gauze: diameter of Sieve, 5 inches; Apertures in the gauze, 30, 50, and 100 to the inch. (Fig. 70.) Per set, 4s.

71. Box Sieve, Cylindrical, 3 inches in diameter, japanned metal, with three divisions each, having a metallic gauze bottom; size of the gauzes 100, 50, and 30 to the inch; with cover. Fig. 71. By this Sieve, a powder is divided by one operation into three degrees of fineness. 4s. 6d.

PORCELAIN SIEVES.—Refer to the article on “Drainers,” under the head of FILTRATION.

- ## 72. SIEVES with Metal Wire Bottoms and Wooden Rims.

Diameter.	17 Hole Iron Wire, 289 Apertures per sq. inch.	30 Hole Iron Wire, 900 Apertures per sq. inch.	17 Hole Brass Wire, 289 Apertures per sq. inch.	30 Hole Brass Wire, 900 Apertures per sq. inch.	70 Hole Brass Wire, 4,900 Apertures per sq. inch.
5-inch ..	1s. 8d.	1s. 10d.	1s. 10d.	2s. 6d.	4s. 3d.
6-inch ..	1s. 8d.	2s. 0d.	2s. 0d.	2s. 8d.	4s. 6d.
8-inch ..	1s. 10d.	2s. 3d.	2s. 3d.	2s. 10d.	4s. 9d.
10-inch ..	2s. 0d.	2s. 6d.	2s. 6d.	3s. 0d.	5s. 6d.

SIEVES of other sizes or forms, and with Lawn or Horsehair Bottoms, can be supplied to order.

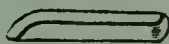
POWDER SCOOPS, or Powder Lifters.

73. Berlin Porcelain, $4\frac{1}{2}$ inches long,
Fig. 73, 1s. 6d.



73.

74. Thuringian Porcelain, two sizes,
form of Fig. 73.



75.



77.

- No. 1, $5\frac{1}{2}$ inches by $2\frac{1}{4}$ inches wide, 10d. No. 2, $4\frac{1}{2}$ inches by 2 inches wide, 8d.

75. Berlin Semi-Porcelain, form of Fig. 75, $4\frac{1}{2}$ inch, 8d.

76. " " " 73, $4\frac{1}{2}$ inch, 8d.

77. Horn, Fig. 77, 3 inch, 6d.; 4 inch, 8d.; 4½ inch, 10d.

SPOONS.

78. Berlin Porcelain Spoon for Acids, size and shape of a teaspoon, glazed, 9d.

79. Spoons of German Semi-Porcelain, with hard white porcelain glaze, form of a teaspoon, Fig. 82—contents $1\frac{1}{2}$ drachm, 7d.

30. Spoons of German Semi-Porcelain, form of a table spoon, Fig. 82—contents 7 drachms, 1s.

82.



83.



RESDEN PORCELAIN SPOONS, glazed.

31. Round Bowl, $1\frac{1}{2}$ inch diameter, holds $\frac{1}{4}$ ounce, Fig. 87 *b*, 1s. 3d.

32. Form and size of a table spoon, Fig. 82, 3s.

2. Form and size of a table spoon, Fig. 82, 3s.
3. Round Bowl, pierced with holes, Fig. 83, for lifting crystals from a solution, 4s. 6d.



84.

4. Ditto, Fig. 84, 2s. 3d.

5. Bohemian Glass Spoons, massive, Fig. 85

- No. 1. 2 drachms, 9d.

- No. 2. 4 drachms, 10d.

- No. 3. 5 drachms, 1s.

- No. 4. 5 drachms, cut and polished all over, 3s. 6d.



85.

86. Bohemian Glass Spoons, massive, form of Fig. 86.

No. 1. 2 drachms, 9d.

No. 3. 5 drachms, 1s.

No. 2. 4 drachms, 10d.

86.

87. German Glass Spoons, slight, 6-inch, various forms (Fig. 87, *a*, *b*, *c*), 2d. each.

88. Horn Tea Spoon, 5 inch, 4d.

89. „ Dessert Spoon, 6½ inch, 7d.

90. „ Table Spoon, 9 inch, 10d.

91. TEST SPOON of polished German silver, with a bowl ¼-inch diameter, for lifting small quantities of powder, the handle fashioned into a spatula for mixing fluxes, &c. in blowpipe and other experiments, 3½ inches long, 3d.

92. Small Iron Spoons, for trying whether substances are combustible or incombustible, for charring organic bodies, or for preliminary fusions in analysis, &c., ¾-inch bowl, 2d. each.

93. Spring Steel Tongs, to hold the iron spoon, 6d.

94. Iron Spoon, attached to a pair of nippers, 9d.

95. Iron Spoon, hemispherical bowl, ½ inch in diameter, turned thin and polished, with thin iron cover, and neat polished wood handle, for preparing black flux, or igniting substances over the spirit lamp, Fig. 95, but with a turned wood handle, 3s.

95.

PLATINUM BLOWPIPE SPOONS. See “Blowpipe Apparatus.”

SPATULAS and STIRRERS.

I.—METAL SPATULAS.

96. Platinum Spatulas, form of Fig. 96.

The following prices are merely approximate, and vary with the weight of the spatula and the market price of the metal.

No.	Length.	Greatest Width.	Weight.	Price.
1.	2½ inch.	$\frac{3}{8}$ inch.	80 grains.	6s. 6d.
2.	3 inch.	$\frac{7}{16}$ inch.	100 „	8s. 6d.
3.	3½ inch.	$\frac{1}{2}$ inch.	130 „	10s. 6d.
4.	4 inch.	$\frac{1}{16}$ inch.	170 „	14s.
5.	4½ inch.	$\frac{5}{8}$ inch.	200 „	16s.
6.	6 inch.	$\frac{5}{8}$ inch.	300 „	24s.

If Platinum Spatulas are made thick in the middle and feathered off towards the sides, the prices are higher than as stated above.

97. Platinum Spatulas made of round or flatted platinum wire, from ⅓ inch to 1 inch thick, and 2, 3, or 4 inches long, price according to weight, at a penny per grain.

98. German Silver Spatula, with Spoon, $3\frac{1}{2}$ inch,
Fig. 98, 3d.



98.

99. Polished Steel Spatulas, flexible blades, with
coco handles and balance shoulders,
Fig. 99.



99.

4 inch,	8d.	7 inch,	1s. 3d.	10 inch,	2s. 3d.
5 inch,	10d.	8 inch,	1s. 6d.	11 inch,	2s. 9d.
6 inch,	1s.	9 inch,	1s. 9d.	12 inch,	3s. 6d.

100. Polished Steel Spatula, 3-inch, bone handle, 8d.

101. Polished Steel Spatula, without handle,
4 inches long, 1s.



101.

102. Polished Iron Spatulas, Fig. 102.

6 inch, 8d. 7 inch, 10d. 8 inch, 1s. 9 inch, 1s. 2d.

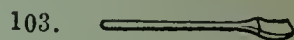
102.



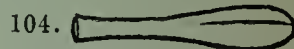
II.—PORCELAIN SPATULAS, glazed.

103. No. 1, Fig. 103, 8 inches long, 1s.

104. No. 2, Fig. 104, 11 inches long, $2\frac{1}{2}$ inches broad, 3s.



103.



104.

Thuringian Porcelain Spatulas, three patterns,

Figs. 105, 106, and 107, stout, glazed all over.

N.B.—The inches are Leipsic measure, and about $\frac{1}{12}$ less
than English.

105. Spatula with Spoon at one end.

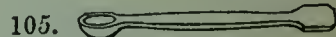
No. 1, 18 inch, 2s. 9d.

„ 2, 15 inch, 2s.

No. 3, 12 inch, 1s. 9d.

„ 4, 9 inch, 1s.

No. 5, 6 inch, 10d.



105.



106.



107.

106. Spatula with handle.

No. 1, 18 inch, 3s. 6d.

„ 2, 15 inch, 2s. 6d.

No. 3, 12 inch, 2s. 3d.

„ 4, 9 inch, 1s. 9d.

No. 5, 6 inch, 1s. 6d.

107. Double Spatula.

No. 1, $18\frac{1}{2}$ inch, 2s. 6d.

„ 2, 15 inch, 1s. 9d.

No. 3, $12\frac{1}{2}$ inch, 1s. 6d.

„ 4, 9 inch, 1s.

No. 5, 6 inch, 8d.

108. Berlin Semi-Porcelain Spatulas, form of Fig. 106, with handle, glazed.

4, 5, or 6 inch, each 1s.

7, 8, 9 inch, each 1s. 9d.

10, 11, 12 inch, each 2s. 6d.

13, 14, 15 inch, each 3s. 6d.

109. Dresden Porcelain Spatulas.

No. 1. Single, form of Fig. 109, $5\frac{1}{2}$ inch, 5d.

$8\frac{1}{2}$ inch, 6d.

No. 2. Double, form of Fig. 107, $8\frac{1}{2}$ inch, 8d.



109.

No. 3. Double, form of Fig. 109 a, $12\frac{1}{4}$ inch, 1s. 6d.

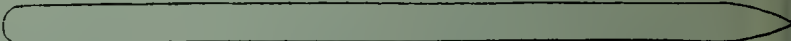


109 a.

III.—FIRECLAY AND STONEWARE STIRRERS.

110. Infusible Fireclay Stirrers for mixing Powders in Crucibles, in Assaying.
7 inch, 6d. 8 inch, 8d. 14 inch, 10d.
111. Saltglazed Stoneware Spatula, round, 9 inches long, $\frac{1}{3}$ inch diameter, 2d. each, 1s. per dozen.
112. Saltglazed Stoneware Spatula, stout, broad at one end, Fig. 109, 10 inches long, 6d.

IV.—GLASS SPATULAS AND STIRRERS.

113. Bohemian Glass Spatulas, massive, from 8 to 10 inches in length, the broad end 1 inch to $1\frac{1}{4}$ inch, the rod $\frac{1}{2}$ inch thick, Fig. 113.  1.
- No. 1. Cut and polished all over, Fig. 2, 2s.
,, 2. The broad end cut and polished, 1s.
,, 3. Uncut, Fig. 1, 10d.
114. Glass Spatula, with broad end, Fig. 114, 6 inches long, 3d.  114.
115. GLASS STIRRERS, made of round glass rod, with one end pointed for dropping tests, and the other end rounded, Fig. 115. *Per dozen.*  115.
- | | | |
|-------------|--------------------|-------------------------|
| 3 inch, 2d. | 9 inch, thin, 8d. | 12 inch, thin, 1s. |
| 6 inch, 4d. | 9 inch, thick, 1s. | 12 inch, thick, 1s. 6d. |
116. Glass Rod in lengths of about 3 feet, and from $\frac{1}{8}$ inch to $\frac{1}{2}$ inch in thickness, per lb. 1s. 4d.

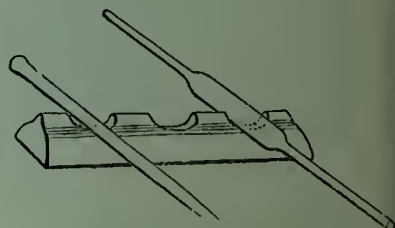
117. Horn Spatulas, for cleansing mortars, &c., various shapes, Fig. 117 and others, at 4d. to 1s. each.

118. Porcelain Rests for Stirrers and Pipettes, to keep the wet end from the table.

- a. 3 inch with 6 notches, 6d.
b. 4 inch with 8 notches, 9d.
c. 6 inch with 12 notches, 1s.



117.

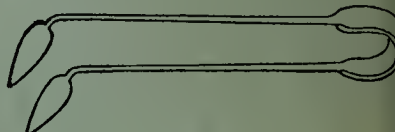


118.

119. Mohr's Clock-work Movement for continually stirring a mixture while being heated in an evaporating basin, complete, 31s. 6d.

TONGS, FORCEPS, PLYERS, &c.

120. CHARCOAL TONGS, with bent points, for arranging charcoal in furnaces, &c., Fig. 120, bright iron.
14 inch, 1s. 6d. 16 inch, 1s. 9d. 18 inch, 2s.



120.

121. SMALL CRUCIBLE TONGS, for use with Platinum Crucibles, with ring handles and bent points, 8 inches long, Fig. 121.

- No. 1. Black Iron, 1s. 2d. | No. 3, Brass, 1s. 9d.
,, 2. Bright Iron, 1s. 6d.



121.

122. Small Crucible Tongs, of German silver polished, form of Fig. 122, which either clip a crucible by the edge, or grasp it round the middle, 8 inch, 3s. 6d.



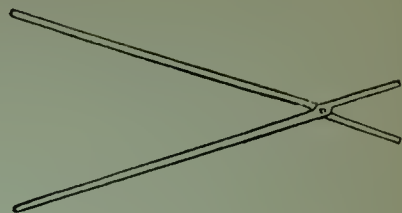
122.

TONGS FOR LARGE CRUCIBLES, Black Iron, stout, unpolished.

123. Straight Tongs, Figure 123.

14	inch,	1s. 4d.
18	inch,	1s. 9d.
25	inch,	2s. 6d.

123.



124. Bow Tongs, Fig. 124.

14	inch,	1s. 9d.
18	inch,	2s.
25	inch,	3s.

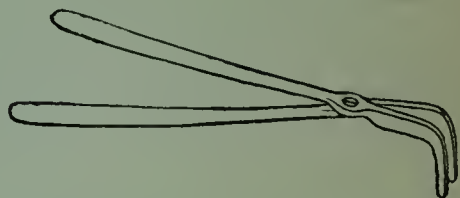
124.



125. Bent Tongs, Fig. 125.

14	inch,	1s. 4d.
18	inch,	1s. 9d.
25	inch,	2s. 6d.

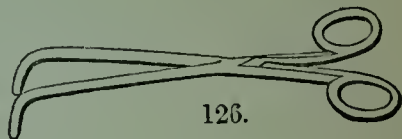
125.



126. Tongs for large Crucibles, polished iron, stout, Fig. 126.

16 inch, bent points, 5s.

126.

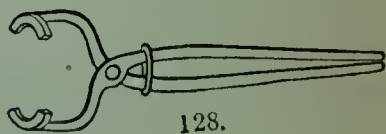


127. Ditto, 16 inch, straight points, 4s.

128. Basket Tongs for lifting heavy crucibles perpendicularly out of furnaces, black iron, unpolished, form of Figure 128.

a.	24 inches long,	$3\frac{3}{4}$ inch basket,	4s. 6d.
b.	25	"	$6\frac{1}{4}$ " 5s. 6d.
c.	32	"	$8\frac{1}{4}$ " 7s.

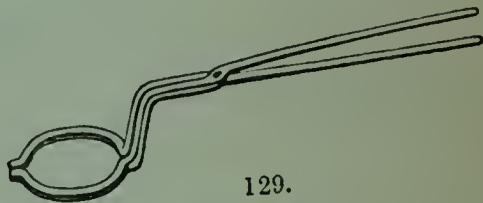
128.



129. Bow Tongs, with bent neck, for lifting crucibles out of furnaces without exposing the hands to the fire.

a.	18 inch handles,	$2\frac{1}{2}$ inch bow,	3s. 6d.
b.	20	"	5 " 4s. 6d.

129.



130. Spring Steel Tongs, for holding platinum cups or spoons in a flame, formed of round steel, Fig.

130a, or flat steel, Fig. 130b, either, 6d.

130 a.

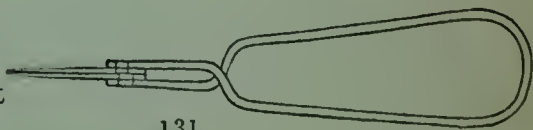


130b.



131. Spring Steel Tongs, mounted with platinum points, Fig. 131, 3s. 6d.

131.



For other varieties of Blowpipe Tongs, consult the article "Blowpipe Apparatus."



132a.



b.



c.

132. Brass Tongs, slight, for lifting weights, trimming lamp wicks, &c., Fig. 132, a, b, c, about $2\frac{1}{2}$ inches long, each 2d.

133. Iron Tongs for lifting weights, trimming lamps, &c., strong, about $4\frac{1}{2}$ inches long, form of Fig. 132 *a*, or of Fig. 135, without the spoon, 6d.
 134. Steel Tongs, same size and pattern, 1s.
 135. Iron Tongs, with spoon-handle, form of Fig. 135, size above $4\frac{1}{2}$ inches long, 9d.
 136. Steel Tongs with spoon, same size, 1s. 6d.



137. Brass Tongs, polished, with fine points, 2s.

137.



138. Polished Steel Tongs, the same pattern, 2s. 6d.

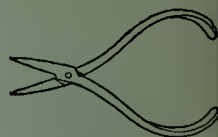
139. Brass Tongs, polished, with ivory points, 3s.

139.



140. Pliers, black steel, with rough points, useful in the repair of apparatus, Fig. 140, 1s. 6d.

140.



141. Cutting Pliers, for cutting wires or pieces of minerals, $5\frac{1}{2}$ inch, 3s. 6d.
 Also, many other kinds of Tongs, suitable for different descriptions of crucibles and furnaces.

SHEARS AND SCISSORS.

142. Tinman's Shears for cutting sheet metals, 9 inch, strong, 2s.]
 143. Scissors for cutting filters, trimming lamps, &c., 5 inch, 1s. 3d.

STOPCOCKS.

SOLID GLASS STOPCOCKS.

144. Stopcock in the middle of a straight narrow glass tube, 12 inches long, and about $\frac{1}{3}$ in. thick, 2s. 6d.



144, 145.

145. Stopcock in the middle of a straight tube, large size, $\frac{1}{2}$ to $\frac{3}{4}$ inch wide, and 20 inches long, Fig. 145, Bohemian glass, 7s. 6d.



146, 147.



148, 149.



150.



151.

146. Stopcock in the middle of a straight tube, both ends conical, 6 inch, 3s. 6d.
 147. Ditto large size, Bohemian glass, massive, 6s. 6d.
 148. Stopcock, the delivering end of which points downwards, 6 inch, 3s. 6d.
 149. Ditto large size, 8 inch, Bohemian glass, massive, 6s. 6d.
 150. Stopcock, the delivering end of which points downwards, and is enlarged to receive a cork, 3s. 6d.
 151. Stopcock in a straight tube, the delivering end of which is enlarged to receive a cork, 3s. 6d.

STONEWARE STOPCOCKS.

152. Nearly resembling Fig. 149, $\frac{1}{4}$ inch 3s., $\frac{1}{2}$ inch 3s. 6d.
 153. Nearly resembling Fig. 146, $\frac{1}{4}$ inch 3s., $\frac{1}{2}$ inch 3s. 6d.

BRASS STOPCOCKS.—See "Pneumatic Apparatus," No. 697.

PINCHCOCKS.

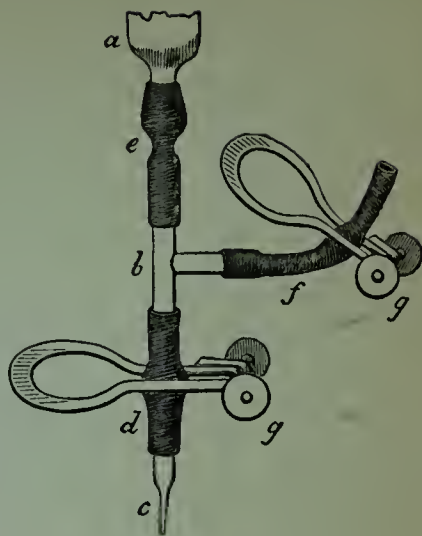
156. Mohr's Pinchcock, Fig. 156 *g*, for closing flexible tubes, to prevent the passage of liquid or gases, three sizes:—

- No. 1. Usual size for Alkalimeters, 6d.
2. Smaller than No. 1, 6d.
3. Larger than No. 1, 1s.



157. Bunsen's Lever Pinchcock, for regulating the flow of gases or liquids through flexible pipes, so as to keep up a constant

157. action at a fixed rate, Fig. 157, 1s. 4d.



156.

158. BRUSHES FOR CLEANING TEST TUBES AND BOTTLES.

1. Brush for cleaning test tubes that are of from $\frac{1}{4}$ inch to 1 inch diameter, 3d.

2. Brush for cleaning narrow tubes, namely, those less than $\frac{1}{4}$ inch diameter, 2d.

3. Brush for cleaning long tubes or Alkalimeters, such as Mohr's Burette, form of Fig. 158, 1, but on long wire, 21 inch, 6d.

4. Brush to clean open narrow tubes, with bristles in the middle, Fig. 158, 4, 3d.



158, 1.



158, 4.

5. Brush for 5-ounce flasks, 4d.

6. Brush for 12-ounce flasks, 6d.

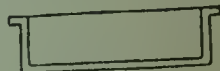
7. Brush for 2-pint flasks, 8d.

8. Brush for 3-pint flasks, 1s.

TRAYS.

Trays for holding Jars in water when filled with gas. These trays also serve to hold acid bottles, and protect the table from corrosion.

159. Round Trays, Berlin Semi-Porcelain, glazed, adapted to receive glass jars when filled with gas, to hold acid bottles, &c., depth $\frac{1}{2}$ inch to $1\frac{3}{4}$ inch, Fig. 159.



159.

No. 000, $2\frac{1}{2}$ inch, 3d.

„ 00, 3 „ 3d.

„ 0, $3\frac{1}{2}$ „ 5d.

No. 1, $4\frac{1}{2}$ inch, 8d.

„ 2, $5\frac{1}{2}$ „ 9d.

„ 3, $6\frac{1}{2}$ „ 10d.

No. 4, $7\frac{1}{2}$ inch, 1s.

„ 5, $8\frac{1}{2}$ „ 1s. 3d.

„ 6, $9\frac{1}{2}$ „ 1s. 6d.

160. Round Trays of Saltglazed Stoneware, flat bottoms, vertical sides, form of Fig. 160, about 1 inch deep.



160.

2 inch, 2d

$2\frac{1}{2}$ inch, 2d.

3 inch, 2d.

$3\frac{1}{2}$ inch, $2\frac{1}{2}$ d.

4 inch, 3d.

$4\frac{1}{2}$ inch, 3d.

5 inch, 3d.

6 inch, 4d.

7 inch, 4d.

8 inch, 6d.

161. The Set of 10 Trays, 2 to 8 inch, 2s. 6d.

162. The Set of 4 Trays, 3, 4, 6, and 7 inch, 1s.

163. Trays of white glazed Wedgwood's Porcelain. Depth $\frac{3}{4}$ inch to 1 inch.

3 inch, 3d. | $3\frac{1}{2}$ inch, 3d. | 4 inch, 4d.

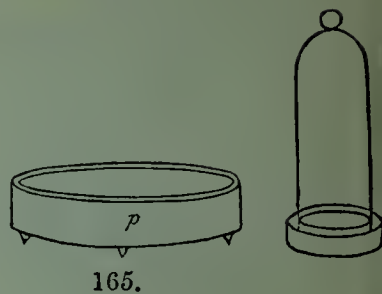
164. Berlin Porcelain Tray, for Gas Tubes, $1\frac{1}{4}$ inch, $1\frac{1}{2}$ inch.

Glass Trays, form of Fig. 160; see Apparatus for Evaporation.

165. Earthenware Trays, yellow colour, glazed, form of Fig. 165, 2 inches deep.

9 inches diameter, 1s. | 12 inches diameter, 1s. 4d.

166. Rectangular Trays, or Flat Pans, of Wedgwood's Porcelain, in which to place acid bottles, small furnaces, &c., to protect the table from corrosion in the event of the spilling of chemicals:—



A. Shallow Trays, $1\frac{1}{4}$ to $1\frac{1}{2}$ inches deep.

Length.	Width.	Price.	Length.	Width.	Price.
6 inches.	5 inches.	8d.	11 inches.	9 inches.	2s.
8 inches.	5 inches.	1s.	11 inches.	10 inches.	2s.
9 inches.	7 inches.	1s. 3d.	13 inches.	11 inches.	4s.
9 inches.	8 inches.	1s. 6d.	15 inches.	11 inches.	5s.

B. Deep Trays, $2\frac{1}{4}$ to 3 inches deep.

Length.	Width.	Depth.	Price.	Length.	Width.	Depth.	Price.
$10\frac{1}{2}$ in.	$8\frac{1}{2}$ in.	$2\frac{1}{4}$ in.	2s. 6d.	$13\frac{1}{2}$ in.	$11\frac{1}{2}$ in.	$2\frac{1}{2}$ in.	6s.
$11\frac{1}{2}$ in.	$9\frac{1}{2}$ in.	$2\frac{1}{4}$ in.	2s. 8d.	$14\frac{1}{2}$ in.	$12\frac{1}{2}$ in.	$2\frac{1}{2}$ in.	8s.
10 in.	8 in.	3 in.	3s. 6d.	20 in.	18 in.	$2\frac{1}{2}$ in.	18s.

Larger Trays than the above, up to 28 inches long, 22 inches wide, and 3 inches deep, made to order.

167. THURINGIAN PORCELAIN TRAYS, FOUR-SIDED.

Approximate Measurements.

No.	Length.	Width.	Depth.
No. 1.	$5\frac{1}{2}$ inches.	4 inches.	1 inch. 2s.
2.	$6\frac{1}{2}$ inches.	$5\frac{1}{2}$ inches.	$1\frac{1}{3}$ inch. 2s. 6d.
3.	$7\frac{1}{2}$ inches.	$6\frac{1}{4}$ inches.	$1\frac{1}{3}$ inch. 3s. 6d.
4.	11 inches.	$7\frac{1}{2}$ inches.	2 inches. 8s.
5.	$13\frac{1}{2}$ inches.	11 inches.	2 inches. 14s.
6.	17 inches.	11 inches.	2 inches. 16s.

CORKS.

168. BEST QUALITY.

LONG CORKS.

No.	Diameter at small end.	Length.	Per Dozen.
1.	$\frac{3}{8}$ to $\frac{1}{2}$ inch.	$\frac{7}{8}$ inch.	2d.
2.	$\frac{5}{8}$ inch.	1 inch.	3d.
3.	$\frac{3}{4}$ inch.	$1\frac{1}{4}$ inch.	4d.
4.	$\frac{3}{4}$ inch.	$1\frac{3}{4}$ inch.	7d.
5.	$\frac{7}{8}$ inch.	$1\frac{3}{4}$ inch.	9d.
6.	1 inch.	2 inch.	1s. 3d.
7.	$1\frac{1}{8}$ inch.	2 inch.	1s. 3d.

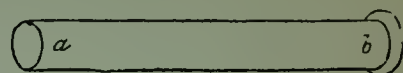
BUNGS.

No.	Diameter at small end.	Length.	Per Dozen.
8.	$\frac{3}{4}$ inch.	$\frac{5}{8}$ inch.	2d.
9.	1 inch.	$\frac{1}{2}$ inch.	3d.
10.	$1\frac{1}{4}$ to $1\frac{3}{8}$ inch.	$\frac{5}{8}$ inch.	6d.
11.	$1\frac{5}{8}$ to $1\frac{3}{4}$ inch.	$\frac{5}{8}$ inch.	7d.
12.	$1\frac{1}{4}$ to $1\frac{1}{8}$ inch.	1 inch.	7d.
13.	$1\frac{1}{2}$ to $1\frac{5}{8}$ inch.	$1\frac{1}{4}$ inch.	8d.
14.	$1\frac{7}{8}$ to 2 inches.	1 inch.	1s.

CORK BORERS AND CORK SQUEEZERS.

CORK BORERS, for piercing cylindrical holes in corks, so as to adapt glass tubes to gas bottles, &c., made of polished brass, with sharpened edges, 6 inches long, and respectively $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{4}$ inch in diameter.

Fig. 169 represents a Cork Borer: *a*, the sharpened end; *b*, the handle. The use of these Borers saves a great quantity of time in the adjustment of tube apparatus for experiments with gases, and, if good corks are used, prevents, in many cases, the necessity of employing lutes. The borer should be kept well sharpened, and be slightly oiled when used.

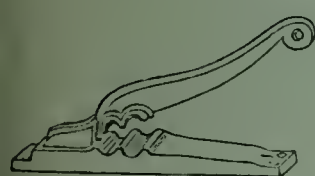


169.

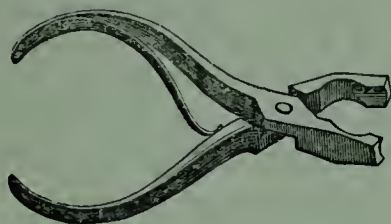
69. Price of the set of Twelve Borers, with handles, in a japanned tin case, with a flat file for resharpenering the edges when necessary, and a rod for expelling the corks from the Borers, 6s.

70. The six smallest Borers, with handles, polished and sharpened, with a Case, File, and Rod, 2s. 9d.

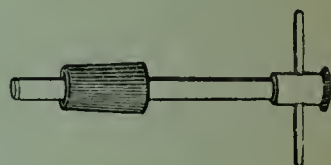
71. A selection of Four Borers, namely, those of $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$ inch diameter, with handles, polished and sharpened, per set, 1s. 6d.



174.



175.



172.

CORK BORERS, SUPERIOR QUALITY, strengthened with a collar and milled head, the collar being pierced to receive a steel rod, to help in pressing the borer through a large cork. Fig. 172.

72. The set of Twelve Borers, from $\frac{1}{8}$ inch to $1\frac{1}{4}$ inch bore, in a case, with file and steel rod, 9s.

73. The set of Six small Borers, from $\frac{1}{8}$ to $\frac{7}{16}$ inch bore, in a case, with file and rod, 5s.

74. Cork Squeezers, japanned iron, with springs.

A. Medium size, for corks up to 1 inch, 2s.

B. Massive, for large corks, 4s.

75. Cork Tongs, steel, Fig. 175. 3s. 6d.

The use of the Cork Squeezers and Cork Tongs is to soften corks by pressure, so as to increase their elasticity, and make it more easy to fit them air-tight to gas bottles. The Squeezer must be screwed to the table. The Tongs is a more portable instrument.

76. Knife for cutting corks.

FILES AND RASPS, FOR SHAPING CORKS, all in neat wooden handles.

77. Round File, bastard cut, 4-inch, 8d.

78. " " 5-inch, 9d.

79. " " 6-inch, 10d.

80. " " 7-inch, 1s.

81. Flat File, bastard cut, 6-inch, 9d.

82. " " 8-inch, 1s.

83. " " 10-inch, 1s. 6d.

84. Half Round File, bastard, 6-inch, 10d.

85. " " 8-inch, 1s.

186. Flat Rasp, rough cut, 4-inch, 8d.

187. Flat Rasp, rough cut, 8-inch, 10d.

188. Round Rasp, " 4 inch, 8d.

189. " " 5-inch, 6d.

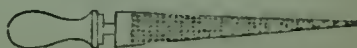
190. " " 6-inch, 1s.

191. Half Round Rasp, rough, 6-inch, 1s.

192. Flat File for sharpening cork borers, 6d.



177.



186.

193. ELASTIC AIR-TIGHT STOPPERS for Bottles or Tubes, of the form of corks, but made of VULCANISED CAOUTCHOUC.

N.B.—These Stoppers are solid, but can be easily pierced with holes to fit glass tubes, by means of the ordinary cork-borers, which must be sharp, clean, and wetted with alcohol when used for this purpose. See Fig. 172.

No.	Length.	Width at Top.	Width at Bottom.	Per Dozen.	No.	Length.	Width at Top.	Width at Bottom.	Per Dozen.
00	$\frac{3}{4}$ inch.	$\frac{1}{2}$ inch.	$\frac{3}{8}$ inch.	1s. 6d.	3	1 inch.	$1\frac{1}{8}$ inch.	$\frac{7}{8}$ inch.	4s.
0	$\frac{7}{8}$ "	$\frac{5}{8}$ "	$\frac{1}{2}$ "	2s.	4	$1\frac{1}{8}$ "	$1\frac{3}{8}$ "	1 "	5s.
1	$\frac{3}{4}$ "	$\frac{3}{4}$ "	$\frac{5}{8}$ "	2s. 6d.	5	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "	$1\frac{1}{4}$ "	7s.
2	$\frac{7}{8}$ "	1 "	$\frac{3}{4}$ "	3s.	6	$1\frac{1}{2}$ "	$1\frac{5}{8}$ "	$1\frac{3}{8}$ "	8s.

ATOMIC SYMBOLS.

194. ATOMIC SYMBOLS FOR THE ILLUSTRATION OF THEORETICAL SUBJECTS AT CHEMICAL LECTURES: consisting of Coloured Cubes of Pottery, about two inches square, intended to represent chemical atoms or gaseous volumes. They can be easily grouped, so as to illustrate the atomic constitution of compounds, the theory of combination in volumes, and the double decomposition of salts, and to illustrate various chemical doctrines by equations. The following series of sixty models is sufficient to explain the formulæ of most frequent occurrence. *Price of the set of sixty models, in a neat black wood cabinet, 31s. 6d.*

195. The Models separately at the following prices:—

White Biscuit Ware, 4d.
Painted any Colour, 6d.

Gilt, Silvered, Coppered, or two Colours, 8d. each.

Colour of Models.	Elements Indicated.	Pieces in the Set.	Colour of Models.	Elements Indicated.	Pieces in the Set.
Black	Carbon	10	Pink	Phosphorus	2
Pale Blue	Hydrogen	20	Gold Bronze	Light Metals	2
Scarlet	Oxygen	6	Copper Bronze	Heavy Metals	2
White	Nitrogen	4	Blue and Black	Organic Radicals	4
Pale Green	Chlorine	4	Brown	Neutral Gases	4
Yellow	Sulphur	2			

STENCILS FOR PREPARING DIAGRAMS.

196. Diagram Alphabets, or sets of Stencil Plates, for making letters or figures upon diagrams, cut in thin zinc.

A, B, C to Z.	a, b, c to z.	Set of 10 Figures.
1 inch, 3s.	1 inch, 3s.	1 inch, 1s.
2 " 6s.	2 inch, 6s.	2 inch, 2s.
3 " 7s. 6d.	3 inch, 7s. 6d.	3 inch, 3s. 6d.

197. Cakes of Black Ink for stencil painting, 4d. 198. Stencil Brushes, 4d.

199. DIAGRAM PAPER, very stout, hard sized, bearing colours, size 56 inches by 36 inches, per sheet, 4d. 200. Ditto, per quire, 6s.

201. Diagram Paper, mounted on cloth, in sheets measuring 56 inches by 36 inches, per sheet, 1s. 6d.

CHEMICAL DIAGRAMS FOR CLASS ILLUSTRATIONS, consisting of large Coloured Engravings, mounted on cloth, with brass eyelet holes to facilitate suspension by hooks.

202. Diagram of a Blast-Furnace for smelting iron ore, shown in section on the scale of half an inch to one foot; size, 33 inches by 21 inches; coloured; mounted on cloth, 2s.

203. Diagram of a Gas-Works, showing the progress of the gas from the retort where it is made through the condensers, purifier, governor, meter, into the main; size, 33 inches by 63 inches; coloured; mounted on cloth, 5s.
204. Diagram of the interior of a Glass-House, with glass-blowers at work; size, 35 inches by 52 inches; coloured; mounted on cloth, 3s. 6d.
205. Diagram showing the chief Chemical Ingredients in twenty-three of the most important articles of Food; size, 35 inches by 78 inches; coloured to show percentages; mounted on cloth, 5s.
206. Diagram of National Dietaries; coloured to show the chief chemical ingredients of the food in ounces per week: eleven examples; size, 35 inches by 26 inches; mounted on cloth, 1s. 6d.

GLASS-BLOWING.

211. Glass-blower's Table, 31 by 22 inches, covered with zinc; 14-inch double bellows, with brass ball and socket jet, and two iron weights for the bellows, £4 4s.
Letter *c*, Fig. 211, represents the gas jet, No. 227.
212. Another similar Table, of smaller size, top 27 by 18 inches, covered with zinc, bellows 12 inches, £3 12s.
213. Another Table, cheaper construction, table top 27 by 26 inches, not covered with zinc; 12-inch bellows, simple glass jet, without ball and socket joint, 56s.
214. Glass-blower's Table, French pattern, with circular bellows, in iron cylinder, top covered with zinc, 24 by 18 inches, with ball and socket jet, Fig. 214, £4 4s.
215. Tate's Water-pressure Blowpipe, Fig. 215. This apparatus serves also for use as a pneumatic trough, and will be found so described under the head of Gas Apparatus, 16s.
216. Tilley's Water-pressure Blowpipe, Fig. 216, height 17 inches, width 5 inches, length 9 inches, japanned tinplate, 12s. 6d.

a, partition separating the apparatus into two parts: *w*, *w*, height of the water; *b*, flexible cloth pipe by which air is blown in; *c*, valve to prevent the return of water; *d*, flexible metal pipe leading to the flame; *e*, glass jet; *g*, one of two handles by which the blowpipe can be strapped to a stool.

217. Toft's Water-pressure Blowpipe, Fig. 217, height 18 inches, form cylindrical, diameter 9 inches, japanned zinc, with two stopcocks, 21s.

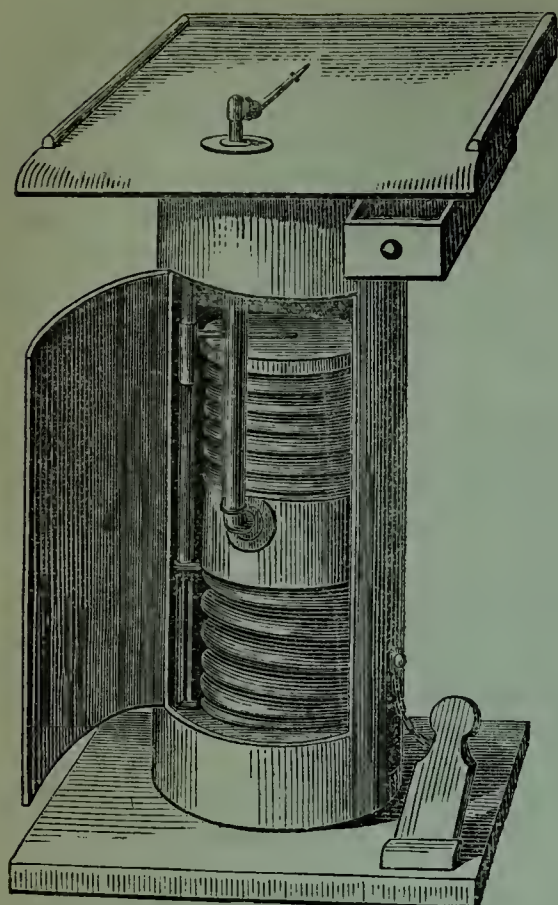
a, horizontal division separating the vessel into two chambers communicating by the tube *b*; *e*, *c*, pipe by which air is blown in, *e* being a flexible cloth pipe; *f*, *d*, pipe by which air passes to the flame; *g*, *h*, brass stopcocks; *f*, bent brass pipe; *l*, glass jet; *i*, an opening to permit atmospheric pressure; *k*, handle by which the blowpipe can be strapped to a table.—The lower chamber of this blowpipe can be entirely emptied of air, and then filled with oxygen gas, by connecting a bladder of gas to the stopcock *g*, after removal of the pipe *e*. Hence it can be used as an oxygen gas blowpipe.

218. Danger's Portable Blowpipe, with bladder reservoir, Fig. 218, 14s.

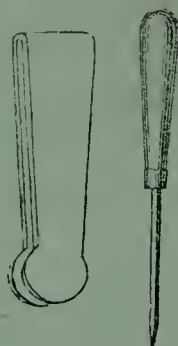
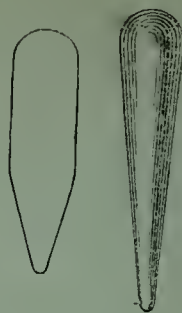
a, wooden clamp to serew to a table; *b*, bladder reservoir, from which the air is expelled by pressure, either using the knees or attaching weights; *c*, flexible cloth pipe by which air is blown in; *f*, boxwood knee with valve to prevent the return of the air; *e*, flexible metal pipe to convey air to the flame; *d*, glass jet; *o*, air chamber with which all the pipes communicate.

219. Kreidl's Hydrostatic Blowpipe, consisting of a glass Woulff's Bottle of three necks, 6-pint size, with 33-inch pressure funnel, a blowpipe jet, and a blowing tube, 9s.

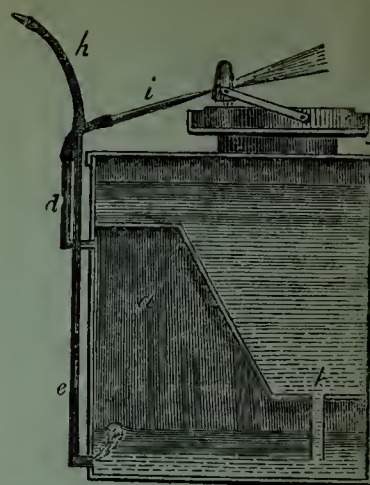
For descriptions of other apparatus suitable for glass-blowing, consult the article on Deville's Chemical Forge, and the section on "Blowing Machines."



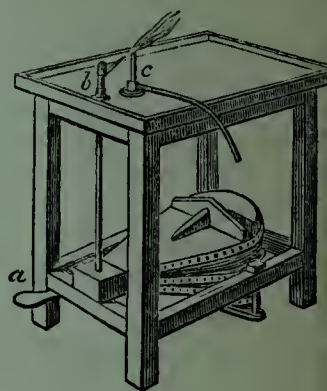
214.



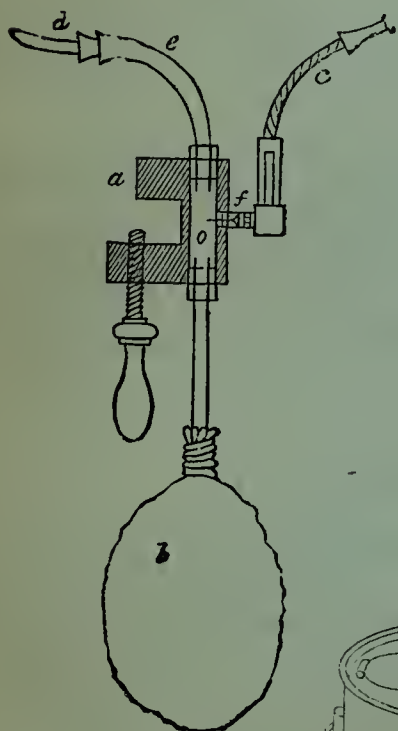
228.



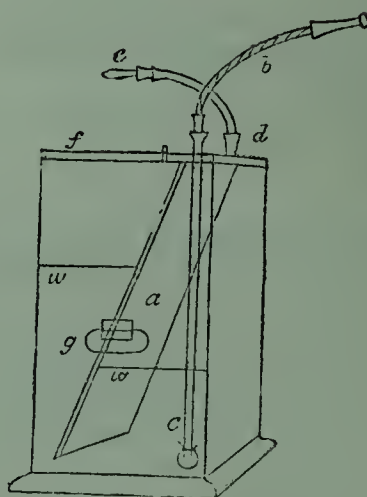
215.



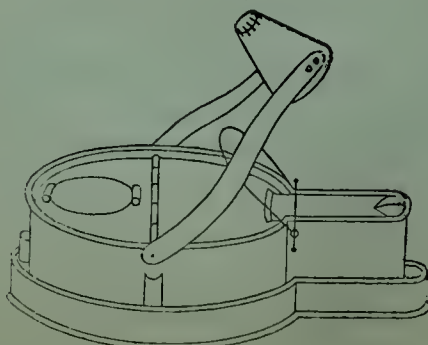
211.



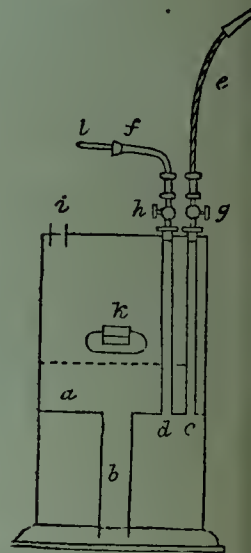
210.



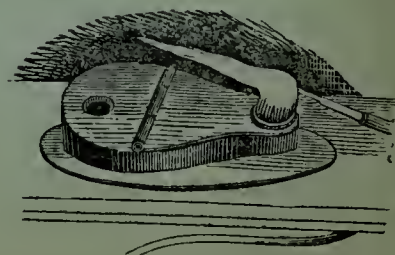
216.



223.

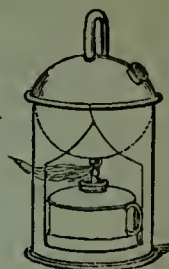


217.



224.

220. Reid's Mouth Blowpipe, attached to an oil lamp, for glass-blowing, suitable for small operations, 5s.
221. Eolipile, or Spirit Blowpipe, with copper ball, for bending glass tubes, 5s.
223. Danger's Improved Glass-blower's Lamp, with arrangement for altering the size and height of the wick, and hood to prevent smoke, increase the heat, and keep the flame from the operator's eyes, and with tray to catch overflowing oil, Fig. 223, 4s. 6d.
224. Glass-blower's Lamp, common oval form, with tray, tinplate, Fig. 224, 3s.
225. Cotton Wick for the Glass-blower's Lamp, per bundle, sufficient for three large wicks, 1s.
226. Blowpipe Jet to screw to a table, with ball and socket joint, adapted either for a lamp or a gas flame, Fig. 211 *b*, and on Fig. 214, 6s. 6d.
227. Gas-burner to use with the Glass-blower's Table, with foot and stopcock, *c*, Fig. 211, 2s. 6d.
228. Set of Glass-blower's Tools, consisting of iron rod in handle, iron cone, pair of flat brass tongs, flat iron plate, Fig. 228, 2s. 6d.
229. Triangular File for cutting glass tubes, 3 in., with handle, 8d.
230. Pastilles, Fig. 230, but 6 inches long, ; for cutting off the necks of retorts, flasks, &c., and dividing thick glass tubes evenly, (being applied with a red-hot point), per dozen in a box, 1s. 6d.



221.



229.

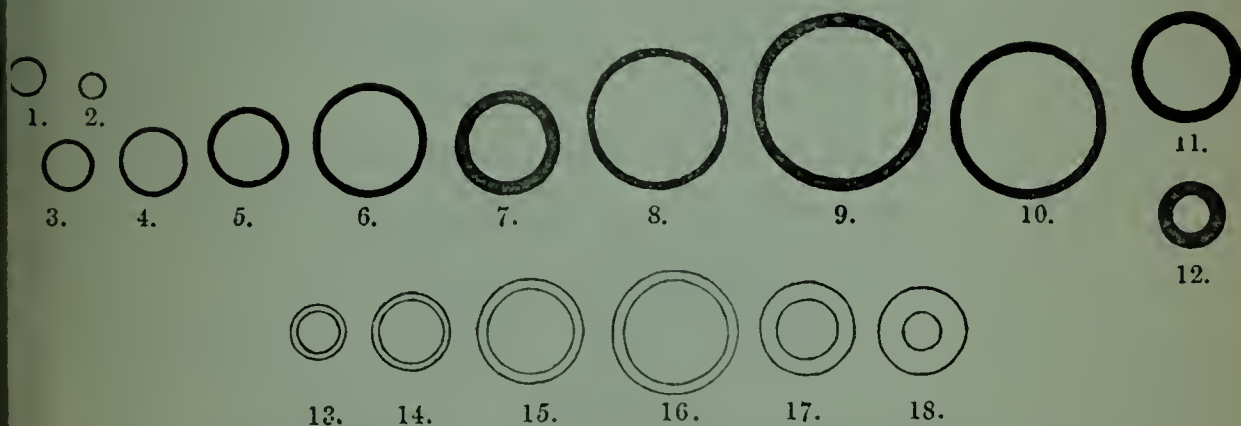


230.

GLASS TUBES, IN LENGTHS OF ABOUT 3 FEET.

Glass tubes are kept in stock, in pieces from 3 to 4 feet long, sometimes 6 feet long ; but it often happens that it is not easy, or rather, not *economical* to pack them when of that length. On this account, when only 1 lb. or 2 lb. is ordered, they are generally cut to the length of 18 to 24 inches. Those who desire to have them of the full length are desired to give orders to that effect, in which case packing boxes will be made to suit them.

Please to order Tubes according to the Nos, given to the following Figures :—



232. One pound of any kind of Glass Tube from No. 234 to 238, at 1s. 4d.
233. Twenty pounds, assorted, at 1s. 2d. Fifty pounds, at 1s.
234. Soft French Glass, free from lead, easy to work at a lamp, adapted for gas delivery tubes, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ inch diameter.
235. Soft German Glass, free from lead, from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch diameter.
236. Hard Bohemian Tube, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{2}$ inch in diameter, for blowpipe experiments.
237. Soft Bohemian Tube, free from lead, from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch diameter.

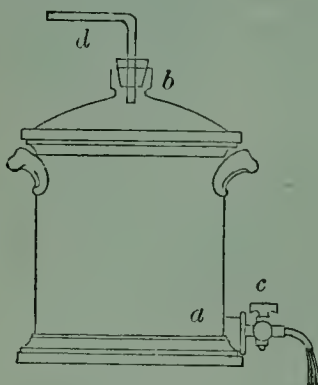
238. Bohemian Combustion Tubes, for organic analyses, of the most infusible glass, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$ inch bore.
240. Short Lengths (6 to 11 inches) of Bohemian Hard Glass Tube, $\frac{1}{2}$ inch to $\frac{3}{4}$ inch bore, per lb. 4d.
241. Solid Glass Rod, for making stirrers, from $\frac{1}{8}$ inch to $\frac{1}{2}$ inch diameter, 1s. 4d. lb.
242. Spindle Tube, of hard glass, size of Figs. 1 to 5, but extremely thin in the glass in order that minute crystals of arsenious acid or other sublimates, deposited inside, may be brought easily within the focus of high powers of the microscope, per lb. 2s.
243. Enamel or Bohemian Coloured Glasses, for fancy glass-blowing, in rods of 12 inches long, and $\frac{1}{4}$ to $\frac{1}{3}$ inch diameter; in packets of 12 rods, assorted colours, 3s.

Black, opaque; Pink, opaque; Crimson, transparent; Blue, pale, opaque; Blue, opaque; Blue dark, opaque; Green, dark, transparent; Green, pale, transparent; Greenish-white, opaque; White, opaque; White, transparent, pearly.

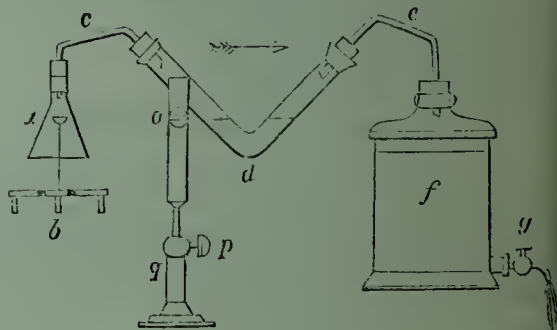
SUPPLY OF WATER. ASPIRATORS, WATER BOTTLES

245. When a vessel which is sufficiently large to contain a considerable quantity of water is provided with one narrow neck at the top and another at the side near the bottom, it can be used both as a Water Bottle to supply the condensing water required in distillations, or as an Aspirator to draw gases through liquids.

Thus, Fig. 246 represents a WATER BOTTLE, which supplies water by the tap *c*, fixed in the neck *a*, while air enters through the tube *d*, fixed in the neck *b*. And Fig. 247 represents an ASPIRATOR, where the discharge of water from the tap *g* causes a current of air to pass from the funnel *a*, in the direction *c*, *d*, *e*, into the bottle *f*, acting in its passage chemically upon the liquid placed in the tube *d*. Vessels made for these purposes may be made of glass, stoneware, or metal; and the stopcocks, or taps, of glass, stoneware, or brass. The capacity must be regulated by the work intended to be done.



246.



247.

246. Water Bottle, form of Figure 246, cylindrical saltglazed stoneware:—

1.	Contents, one gallon,	2s.	Or fitted with brass tap,	4s.
2.	„ two gallons,	4s.	ditto	6s.
3.	„ three gallons,	6s.	ditto	8s.
4.	„ four gallons,	8s.	ditto	10s. 6d.
5.	„ five gallons,	10s.	ditto	12s. 6d.
6.	„ eighteen gals.,	54s.		

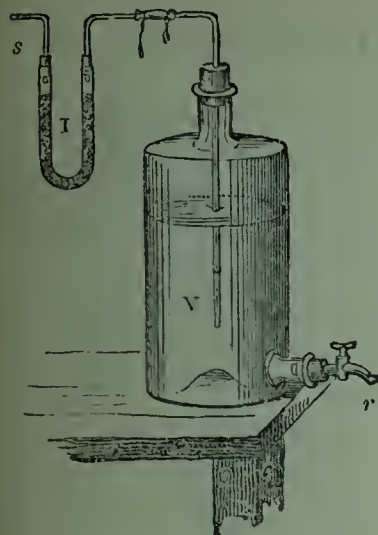
248. Water Casks, Barrel form, saltglazed stoneware, with brass taps:—
One gallon, 4s. 6d.; two gallons, 7s.; four gallons, 12s.

249. Water Bottles, white French glass, tall cylindrical form, with neck at the side.
Fig. 249, but without stopcock.

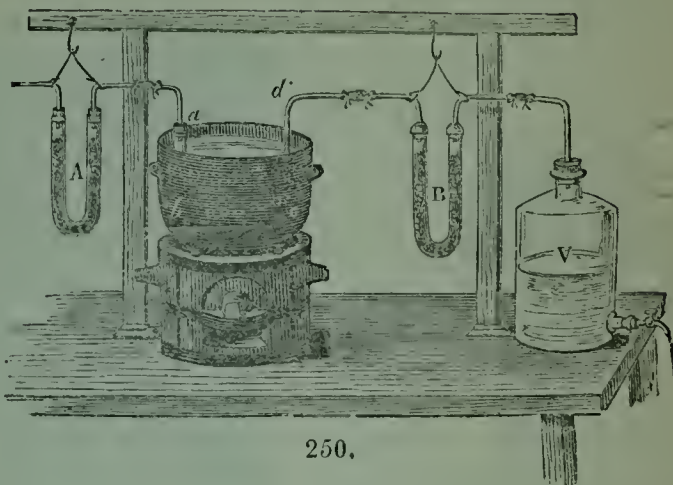
No. 1.	Contents, one gallon, or 5 litres,	4s.
2.	„ two gallons, or 10 litres,	7s.
3.	„ five gallons, or 25 litres,	18s.

50. Water Bottles, German glass, with two necks Fig 250, V, with glass stopcock, ground to the lower neck:—

6 pints	..	8s.	10 pints	..	10s.	20 pints	..	14s.
8 „	..	9s.	16 „	..	12s.	24 „	..	16s.



249.



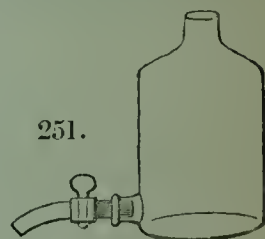
250.

51. Water Bottles of fine white Bohemian glass, with a massive glass stopcock ground to the neck at the side, Fig. 251, capacity 25 to 30 pints, 18s.

52. Water Bottles, Bohemian glass, with two necks, Fig. 251, but without stopcock.

Contents, 2 pints	.	2s. 6d.	Contents, 10 pints	.	7s. 6d.
„ 4 „	.	4s.	„ 20 „	.	12s.
„ 8 „	.	6s.	„ 30 „	.	14s.

251.



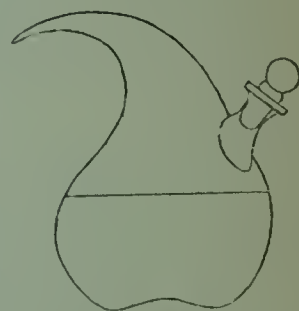
4. Water Bottle, with double tubes, intended for supplying a small quantity of water, or for easily filling tubes and narrow-mouthed vessels with water without using a funnel; Half-pint size, 1s., Pint size, 1s. 6d.

5. Water Bottles for supplying water to flasks, small tubes, filters, &c.. Bohemian glass, stoppered. Can be used with hot water if required.

No. 1, contents	2 ounces,	9d.
2, „	24 „	1s. 6d.
3, „	36 „	2s.



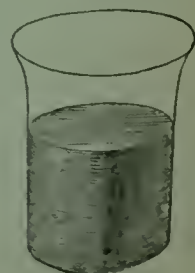
254.



255.

6. Stoneware Stopcock for Water Bottles and Filters, 3s. 6d.

7. Strong Glass Cylindrical Vessel, beaker form, of fine white Bohemian glass, to receive water when run from an Aspirator, or to serve as a well in hydrostatic experiments, or as a dye-bath, &c., capacity about 30 pints, 10s 6d.



257.

258. SILICATED CARBON FILTERS, DAHLKE'S PATENT :—

A. Hard Stoneware, fitted complete, with cover and silver-plated tap.

Two gallons . . . 20s.

Three gallons . . . 27s.

Four gallons . . . 31s. 6d.

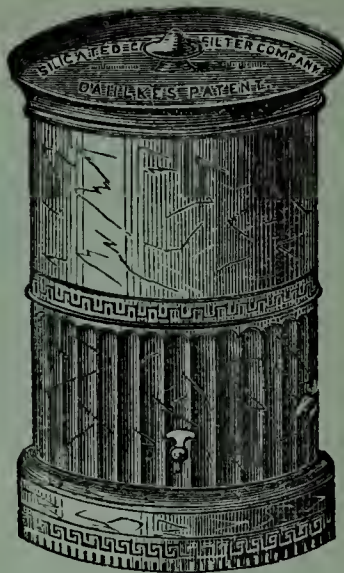
Six gallons . . . 40s.

B. Porcelain Filters, cylindrical form, with electro-plated tap; to filter six gallon per day, 33s.

C. Refrigerative Filter, made of terra-cotta ware, with electro-plated tap, 35s.



A.



B.



C.

THE PRIZE FILTER.

258 D. Constructed in the form of an Etruscan vase, of porous Turquoise. The interior fitted with the patent filtering media is moveable, and the exterior being porous, acts as a refrigerator, keeping the water deliciously cool.

Price, with electro-plated tap, £3 10s.

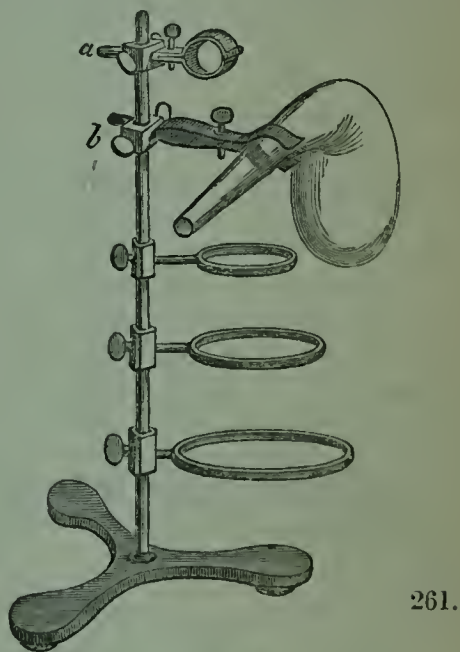
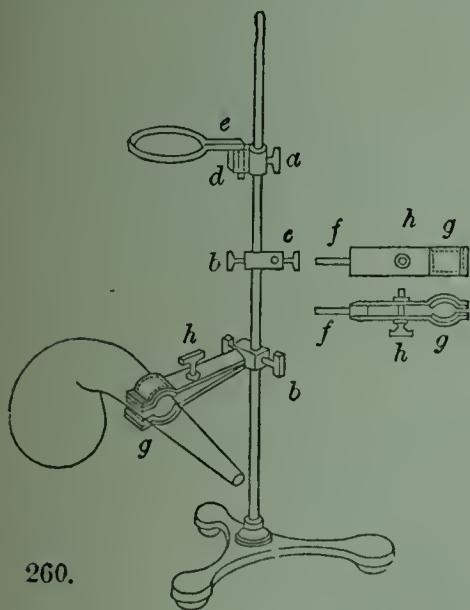


258 D.

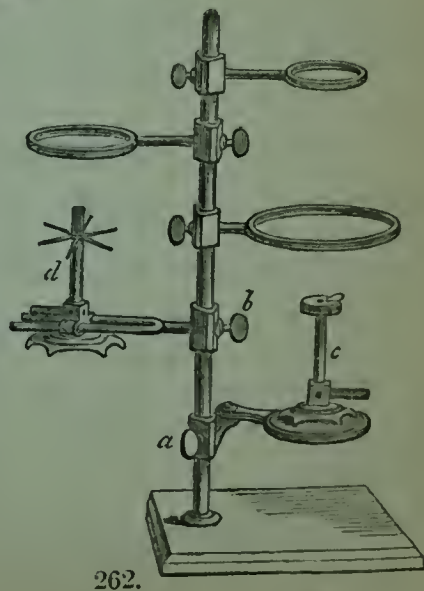
Supports for Apparatus.

CLASS I.—MASSIVE RETORT STANDS, WITH IRON RODS OF $\frac{5}{8}$, $\frac{3}{4}$, OR $\frac{7}{8}$ INCH DIAMETER.

60. Retort Stand, form of Fig. 260, cast-iron foot, with flat upper surface and three balls distant 13 inches, wrought-iron rod 36 inches long, $\frac{7}{8}$ inch diameter; *c*, solid brass block and thumb-screw; *g*, strong brass vice, 6 inches long by $1\frac{1}{2}$ inch wide, fitted by the arm *f* to the hole *c*. This vice serves to support heavy Retorts, as shown in the lower part of the figure; the mouth of the vice is lined with chamois leather; *a*, solid brass socket with thumb-screw, having a square vertical socket, *d*, adapted to the arm of a square solid brass ring, for supporting heavy capsules; with three solid brass cast rings, 5 inch, 6 inch, and 7 inches diameter. Price, complete, 21s.
61. Retort Stand; large and heavy iron tripod base, 13 inches from end to end; iron rod, 36 inches long, $\frac{3}{4}$ inch diameter; three malleable cast-iron rings, 9, $6\frac{1}{2}$, and 4 inches diameter; with triangular collars and thumb-screws; form of Figure 261, without the blocks and branches marked *a*, *b* (for which see Nos. 278, 281, and 285). 15s.



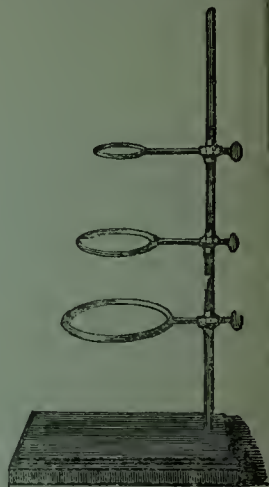
2. Retort Stand; rectangular iron foot, $9\frac{1}{2}$ by 6 inches; iron rod, 28 inches long, $\frac{5}{8}$ inch diameter; three rings of malleable cast iron, $6\frac{1}{4}$, 5, and 3 inches diameter; with triangular collars and screws; form of Figure 262, exclusive of the parts marked *a*, *b*, *c*, *d* (for which see Nos. 273 and 274, and the article "Gas Burners"). 9s.
3. Retort Stand; rectangular iron foot, $9\frac{1}{2}$ by 6 inches; brass rod, 30 inches long, $\frac{5}{8}$ inch diameter; with four strong turned brass rings, $6\frac{1}{2}$, 5, 4, and $2\frac{1}{2}$ inches diameter; made with square arms that slip into square sockets of the form shown by *a*, *d*, *e*, Fig. 260; with two sockets. 16s.



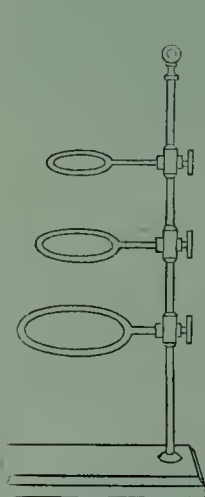
262.

CLASS II. — RETORT STANDS OF MEDIUM SIZE, HAVING IRON RODS OF $\frac{1}{2}$ INCH DIAMETER.

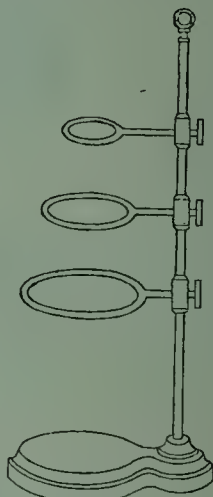
264. Retort Stand; rectangular iron foot, $7\frac{1}{2}$ by $4\frac{1}{2}$ inches; brass rod, 20 inches long $\frac{1}{2}$ inch diameter; three turned brass rings, $4\frac{1}{2}$, $3\frac{1}{2}$, and $2\frac{1}{4}$ inches diameter made with square arms that slip into square sockets in the manner represented by *a*, *d*, *e*, Fig. 260; with two sockets. 12s.
265. Retort Stand; rectangular iron foot, $9\frac{1}{2}$ by 6 inches; iron rod, 24 inches long, $\frac{1}{2}$ inch diameter; three turned brass rings, $5\frac{1}{2}$, $3\frac{1}{2}$, and $2\frac{1}{2}$ inches diameter, each connected with a triangular socket and thumb-screw, Fig. 265. 10s. 6d.
266. Retort Stand; rectangular iron foot, $9\frac{1}{2}$ by 6 inches; iron rod, 24 inches by $\frac{1}{2}$ inch; four bronzed brass rings, $5\frac{1}{2}$, $4\frac{1}{2}$, $3\frac{1}{2}$, $2\frac{1}{4}$ inches; with brass collars and thumb-screws. 8s.
267. Retort Stand; rectangular iron foot, $9\frac{1}{2}$ by 6 inches; iron rod, 24 inches by $\frac{1}{2}$ inch; three iron rings, $5\frac{1}{2}$, $4\frac{1}{2}$, $3\frac{1}{2}$ inches; with triangular collars and thumb-screws. 6s.
268. Retort Stand; rectangular iron foot, $7\frac{1}{2}$ by $4\frac{1}{2}$ inches; iron rod, 20 inches long, $\frac{1}{2}$ inch diameter; three bronzed brass rings, $4\frac{1}{2}$, $3\frac{1}{2}$, $2\frac{1}{2}$ inches diameter. 6s.
269. Retort Stand; oval iron foot, 6 inches diameter; iron rod, 20 inches long, $\frac{1}{2}$ inch diameter; three iron rings, $4\frac{1}{2}$, $3\frac{1}{4}$, 2 inches diameter; with triangular collars and thumb-screws. 4s.
270. Retort Stand; round iron foot, 6 inches diameter; iron rod, 16 inches long, $\frac{1}{2}$ inch diameter, screwed into the centre of the foot; three iron rings, $4\frac{1}{2}$, $3\frac{1}{2}$, 2 inches diameter; with triangular sockets and thumb-screws, Fig. 270. 3s.
271. Retort Stand, similar to the last, but with an iron triangle instead of the smallest ring, 3s.



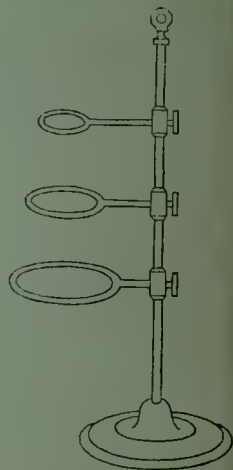
265.



268.



269.



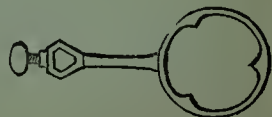
270.

EXTRA FITTINGS FOR LARGE RETORT STANDS.

These fittings are provided with triangular collars, which are made of two sizes: the larger of which suits vertical rods of $\frac{3}{4}$ inch or $\frac{5}{8}$ inch in diameter, and the smaller suits rods of $\frac{5}{8}$ inch and $\frac{1}{2}$ inch diameter.

272. Extra Ring, having three teeth projecting inwards, to support basins over a lamp without cutting off the rising hot air, and without permitting the vessels to become *fixed* in the rings, attached to triangular collars with thumb-screws, Fig. 272. *Four sizes* :—

- | | | | | | |
|------------|----------------|---------------|------------------------|--------------------------|---------|
| 1. Ring, 5 | inch, | collar to fit | $\frac{1}{2}$ inch and | $\frac{5}{8}$ inch Rods, | 1s. 3d. |
| 2. " | $6\frac{1}{2}$ | " | " | " | 1s. 6d. |
| 3. " | $6\frac{1}{2}$ | " | " | " | 1s. 8d. |
| 4. " | 9 | " | " | " | 2s. |



272.

273. Iron Table, $4\frac{1}{2}$ inches diameter, to support spirit lamps, gas burners, &c., upon the Retort Stand, with triangular socket and thumb-screw, and hinged arm, represented by Fig. 273, and by *a* in Fig. 262, suitable for $\frac{1}{2}$ inch and $\frac{5}{8}$ inch rods, 3s.



273.

274. Iron Fork, to support Bunsen's Gas Burner on a Retort Stand, with triangular collar, suitable for $\frac{1}{2}$ inch and $\frac{5}{8}$ inch rods, represented by *b* in Fig. 262, 1s.

275. Iron Fork, for $\frac{1}{2}$ inch and $\frac{3}{8}$ inch Rods, 1s.

276. Brass Fork for Bunsen's Gas Burner, same size as No. 275, 1s. 6d.

277. Iron Block, for attaching to a Retort Stand the following fittings, being such as require a rotating movement for their adjustment; represented by *a* and *b* in Fig. 261, by *d* in Fig. 280, and in other Figures. It has a vertical triangular collar to suit the rod of the Retort Stand, and a horizontal collar to suit the handles of the respective fittings, which are all made of one size, namely, $\frac{3}{8}$ inch diameter:—

277. Block adapted to $\frac{1}{2}$ inch and $\frac{5}{8}$ inch rods, 1s. 6d.

278. Block adapted to $\frac{5}{8}$ inch and $\frac{3}{4}$ inch rods, 2s.

279. Desaga's Clamp, with universal joints to admit of motion in every direction, japanned iron with brass screws, Fig. 279, letters *h* to *n*, price 7s. 6d.

Letter *e* represents the iron block No. 278, and *f* is the thumb-screw that fixes it at the required height on the rod of the Retort Stand; *g* fixes the arm of the Clamp *h*, or allows it to be pushed backwards and forwards, or turned round about. The screw *i* permits the Clamp *k* to be turned round horizontally. The screw *l* regulates the opening of the Clamp, by working against a spiral spring, which tends to keep the jaws of the Clamp apart. *n* and *n* are the forks or jaws of the Clamp. Opposite *m*, at the end of the bar leading from *l*, is a screw which permits the upper jaw of the Clamp to turn a little about, so as to adapt the figure of the two forks to the conical shape of retort necks.

The Retort Stand, Fig. 279, represents also the following articles:—

279a. Iron Rod and Foot, form of Fig. 279 A; size of foot $9\frac{1}{2}$ inches by 6 inches; rod, 28 inches long, $\frac{5}{8}$ inch diameter. 3s.

279b. Plain Malleable Cast-Iron Rings, with bar, adapted to the block No. 278; 3 inch Ring, 8d.—5 inch, 9d.— $6\frac{1}{2}$ inch, 1s.—9 inch, 1s. 3d.

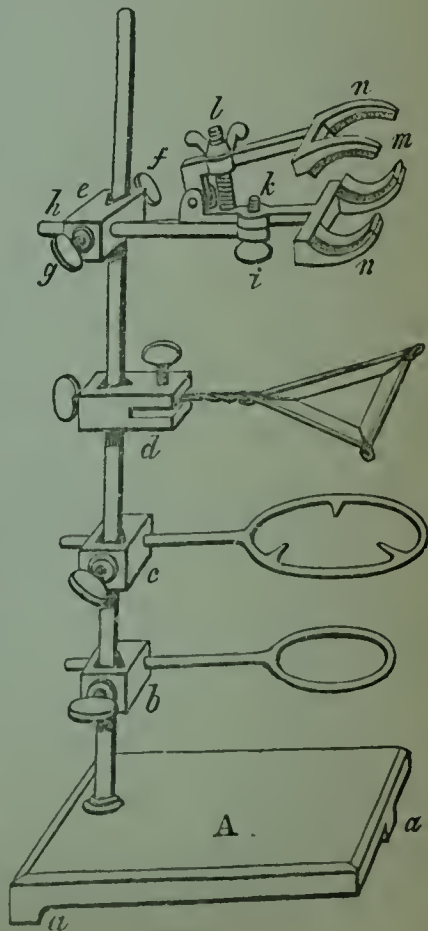
279c. Toothed Rings, similar to Fig. 272, but having an arm adapted to the iron blocks; 5 inch Ring, 9d.— $6\frac{1}{2}$ inch, 1s.—9 inch, 1s. 3d.

279d. Vice to secure the ends of triangles (see Nos. 299 to 308). 3s.

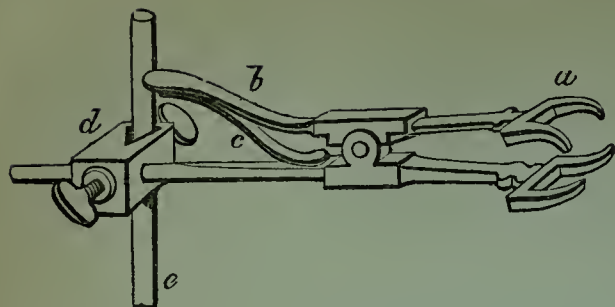
Some of the triangles can be held by the block No. 277, and others can be simply laid across a large ring.

280. Von Babo's Iron Clamp to fasten Retorts to Retort-holders; length from end of *a* to end of *b*, 8 inches. Fig. 280. Price without block, 6s. 6d.

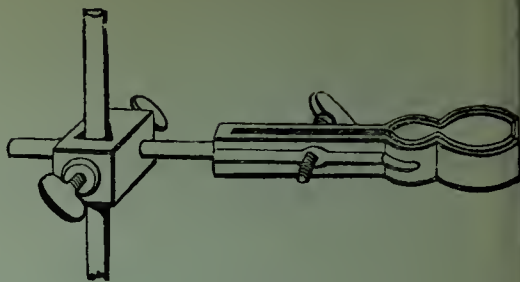
The Retort is held between the forks *a*. The upper fork is moveable on its axis, to adapt the holder to the conical shape of the retort neck. The lever *b* serves to loosen the grip of the forks. The spring *c* keeps the forks close together when there is no pressure on the lever *b*; consequently, the action of the Clamp is readily modified, and the Retort easily placed in any desired position. *e* is the rod of the Retort-stand, and *d* the block by which the Clamp is fastened to it.



279.

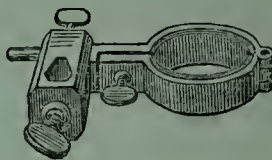


280.



281.

281. Iron Vice for fixing Retorts to a Retort-holder; form of Figure 281; length of the vice part, 7 inches; with hinge (not represented in the Figure). Price without the block, 3s. 6d.
282. Iron Vice, of similar form but smaller size; length of the vice part, 5 inches. Price, without the block, 2s. 6d.
284. Brass Vice for fixing a Retort to a Retort-holder, represented by *f, g, h*, Figure 260, and by *b*, Figure 261, made of strong brass plates, 6 inches long and $1\frac{1}{2}$ inch wide; with screw. Price, without the block, 4s.
285. Condenser Collar, consisting of a strong iron collar for fixing a Liebig's Condenser to a Retort-holder, Figure 285, which shows the collar in connexion with a block, No. 277. Price of the collar alone, 3s.
286. Gas Branch for attaching to the iron block No. 277, by which Gas may be adjusted below any article that requires to be heated. See article "Gas Burners" No. 936 for particulars.



285.

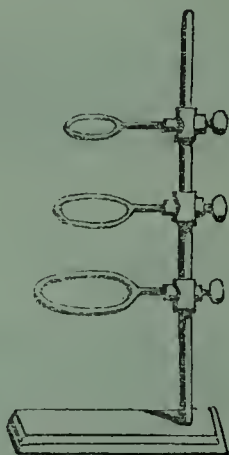


286.

Whenever it is desired to expose to heat small objects upon the rings of large retort-stands, aid must be derived from the TRIANGLES described at Nos. 299 to 308.

CLASS III.—SLIGHT RETORT STANDS, HAVING IRON RODS OF LESS THAN $\frac{1}{2}$ INCH DIAMETER.

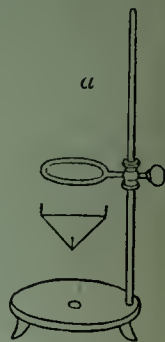
287. Retort Stand; rectangular iron foot, $4\frac{1}{2}$ by 3 inches; iron rod, 11 inches long, $\frac{3}{8}$ inch diameter; three bronzed brass rings 3, $2\frac{1}{4}$, $1\frac{1}{2}$ inch; with brass collars and screws, Figure 287. 2s. 6d.
288. Retort Stand; rectangular iron foot, $5\frac{1}{2}$ by $3\frac{1}{2}$ inches; iron rod, 14 inches long, $\frac{3}{8}$ inch diameter; three bronzed brass rings, $3\frac{1}{2}$, $2\frac{1}{4}$, $1\frac{1}{2}$ inch; with brass collars and thumb-screws, Figure 287. 2s. 6d.
289. Retort Stand; rectangular iron foot, 3 by 2 inches; iron rod, 7 inches long, $\frac{1}{2}$ inch diameter; one brass ring, $1\frac{3}{4}$ inch; with collar and thumb-screw. 1s.
290. Retort Stand, similar to the preceding, but with two brass rings, $1\frac{3}{4}$ inch and $1\frac{1}{4}$ inch, 1s. 6d.
291. Retort Stand; round iron base, 5 inches diameter, on three feet; iron rod, 11 inches by $\frac{3}{8}$ inch; one brass ring, 3 inches; with collar and thumb-screw, and one iron triangle. Fig. 291. 1s. 9d.



287.



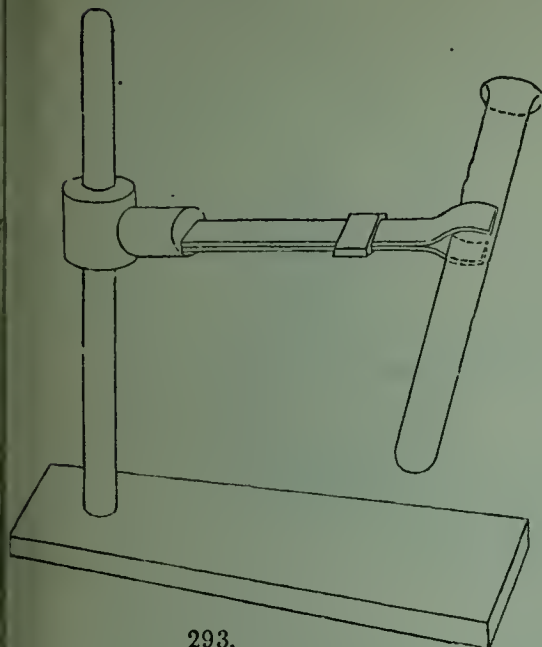
289.



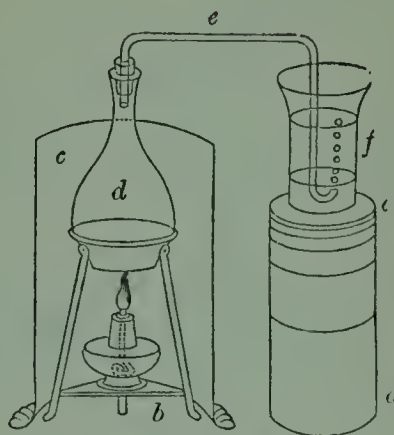
291.

CLASS IV.—TUBE CLIPS, TRIPODS, TRIANGLES, &c.

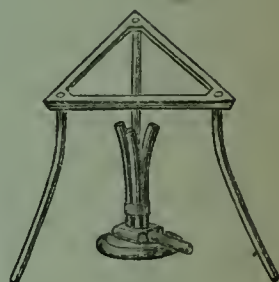
292. Brass Tube Clip or Vice, lined with leather, with iron collar and thumb-screw, adapted for retort rods of $\frac{3}{8}$ inch diameter, 3s.



293.



295.



297.

293. Griffin's Tube Holder, for supporting tubes, retorts, and flasks over a lamp; japanned iron plate, with 16-inch rod and a foot of polished black wood, strongly made, Figure 293, 2s.

294. The same, with rod and foot, of polished mahogany, 2s. 6d.

295. Tripod Stand, for supporting Flasks and Retorts over a small spirit lamp, tinplate body, with zinc legs, Fig. 295 b, 1s. 6d.

296. Screen to use with the Tripod Stand, to preserve the flame of the spirit lamp from currents of air, 12 inches high, zinc, Fig. 295 c, 1s.

297. Iron Tripods, or Triangles on three iron legs. Fig. 297.

No. 1, 5-inch triangle, 8 inches high, 1s.

No. 2, 8-inch triangle, $9\frac{1}{2}$ inches high, 1s. 3d.

No. 3, 10-inch triangle, $9\frac{1}{2}$ inches high, 1s. 6d.

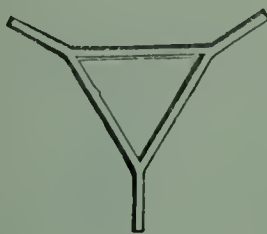
298. Brass Triangle, 5-inch sides, mounted on three brass legs, 8 inches long, 3s.

- TRIANGLES, to support Crucibles, Basins, &c., on Rings, Tripods, or Furnaces.

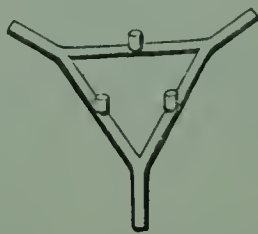
The following measurements signify the length of one side or arm of the Triangle. In general, each Arm is equal in length to one of its Sides.



299.



300.



301.



304.

299. Iron Wire Triangles, with twisted arms, Fig. 299. 3-inch, $2\frac{1}{2}$ d.; 4-inch, 3d. 6-inch, 4d.

300. Malleable Cast-Iron Triangles, Fig. 300. 3-inch, 2d.; 5-inch, 3d.

301. Malleable Cast-Iron Triangles, with pegs on which fireclay cylinders can be supported, to keep basins, &c., from contact with the hot iron, Fig. 301. 3-inch, 3d.; 5-inch, 4d.

302. The same, with the pegs placed where the arms join the triangle, same price as No. 301.
303. Fireclay Cylinders for ditto, per set of three, 6d.
304. Malleable Cast-Iron Triangles, without arms, slender, Fig. 304. 5-inch, 6d. 8-inch, 9d.; 10-inch, 1s.



305.



306.



307.



308.

305. Massive Cast-Iron Triangles, with short feet, but without arms, Fig. 305. No. 00, 7-inch, 8d.—No. 0, 8-inch, 9d.—No. 1, 10-inch 1s.—No. 2, 11-inch 1s.—No. 3, 12-inch, 1s.
306. Iron Wire Triangle, mounted with clay pipes, to prevent contact of the hot iron with a platinum crucible, Fig. 306, 4-inch, 3d.
307. Stout Iron Wire Triangle, 3-inch, fitted with a slender triangle of platinum wire, to support platinum crucibles, Fig. 307, 2s.
308. Malleable Cast Iron Triangle, fitted with a platinum triangle to support platinum crucible, Fig. 308, 2s.

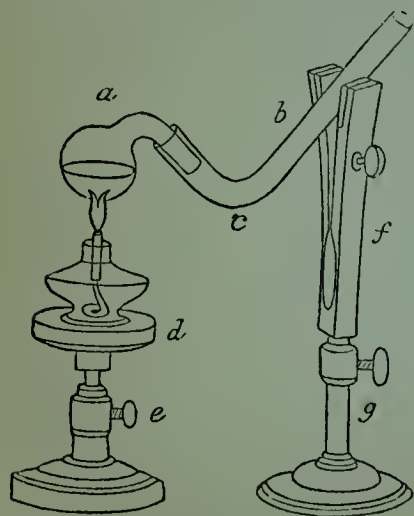
WOODEN SUPPORTS AND HOLDERS FOR VARIOUS DESCRIPTIONS OF APPARATUS

For the convenience of PACKING, the rod of a support is in general not fastened to the foot by the manufacturer, but the purchaser is recommended to fasten it by glue, or other cement, before he puts the support to use.

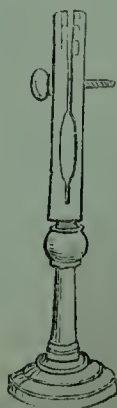
The screws and joints of wooden supports should be protected as much as possible from water, and they should be frequently cleaned from dust, and rubbed with soap or tallow. The thumb-screws of the mahogany supports are made of boxwood. The polished black supports and thumb-screws are made of birchwood.

WOODEN CLAMPS; for holding Tubes, Retorts, and other Apparatus in any desired position.

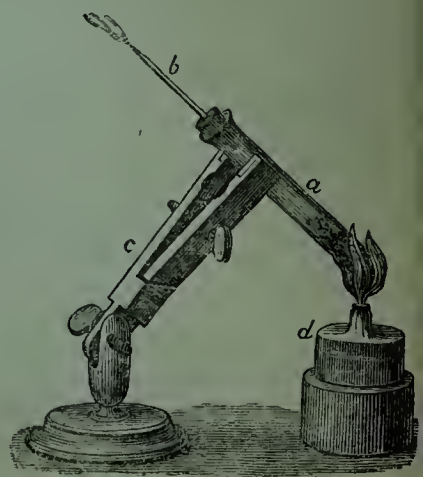
311. VERTICAL CLAMP, for supporting tubes, small retorts, &c., Fig. 311, *f, g*, mahogany French polished, 11 inches rising to 15 inches high, 3s.
312. The same, in polished blackwood, 2s. 6d.
313. Vertical Clamp of a fixed height, 11 inches, Fig. 313, polished black wood, 1s. 8d.



311.

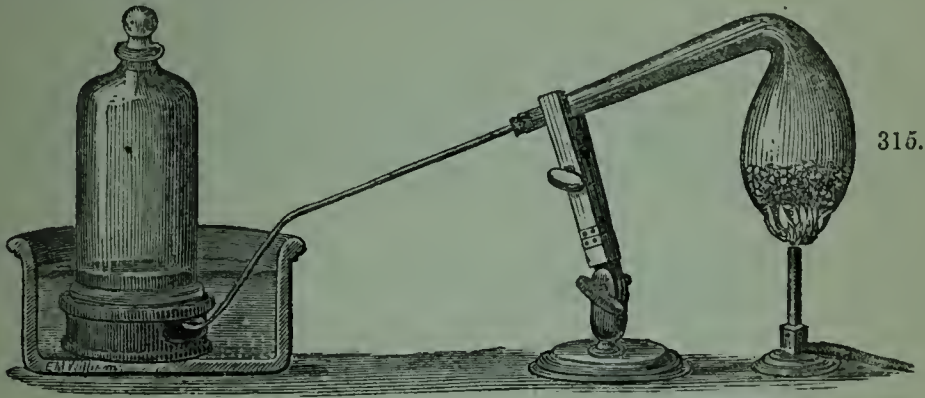


313.



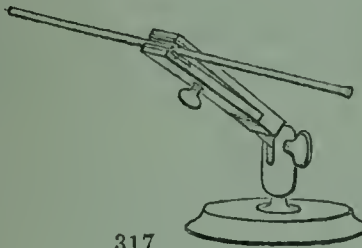
314.

14. HINGED CLAMP, Figs. 314, 315, and 330, for holding tubes in any inclined position, especially useful in distillations and in gas preparations with tube apparatus, polished mahogany, 3s. 6d.
 15. The same, in polished black wood, 3s.
 17. HINGED CLAMP, for supporting tubes in a horizontal position, but at various elevations, useful in adjusting complex arrangements of glass apparatus, Fig. 317, in polished mahogany, 3s. 6d.
 18. The same, in polished black wood, 3s.

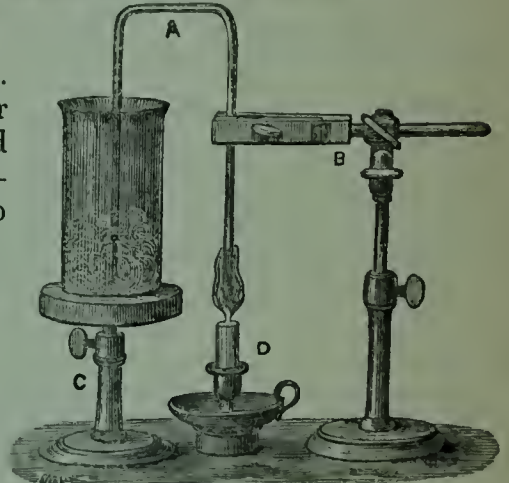


315.

19. BUNSEN'S CLAMP, with UNIVERSAL JOINT, Figs. 319 and 320, with which tubes and other apparatus can be held at any elevation, and in any required position—horizontal, vertical, or oblique. It is strong enough to hold large vessels, as shown by Fig. 320, and delicate enough to suspend small articles by a silk thread. Polished wood.



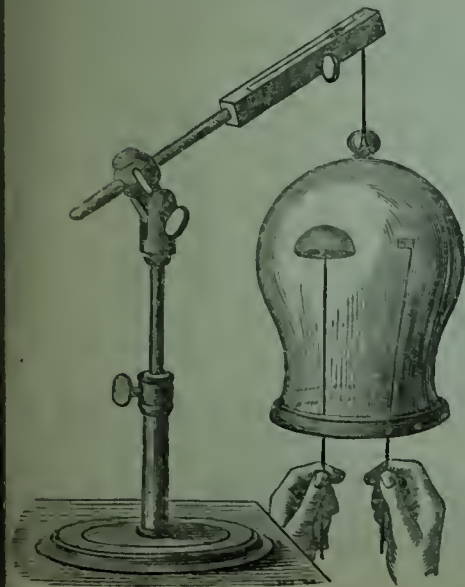
317.



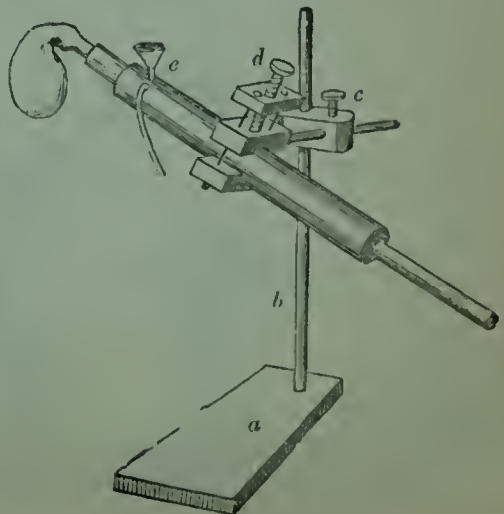
319.

- No. 1. Small size, black wood, 5s.
 2. Small size, mahogany, 6s.

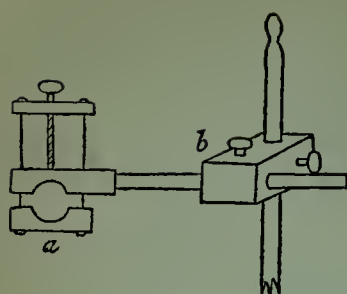
- No. 3. Large size, black wood, 6s. 6d.
 4. Large size, mahogany, 8s.



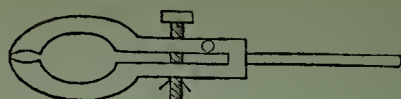
320.



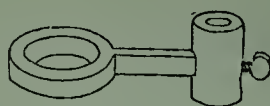
322



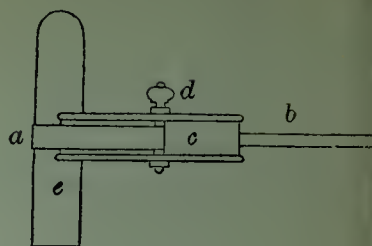
323.



324.



326.



325.

321. UNIVERSAL SUPPORT, adapted for distillations, complicated arrangements of tub apparatus, &c., containing the following articles, all made of hard polished black wood, with boxwood screws, which are sold singly, or altogether for 12s. 6d. :—

322. The Foot, Rod, and Block, for supporting the other pieces, Fig. 322, *a, b, c*, 2s. 6d.

323. Sefstroem's Retort and Flask Holder, Fig. 322 *d*, and 323 *a*, 4s.

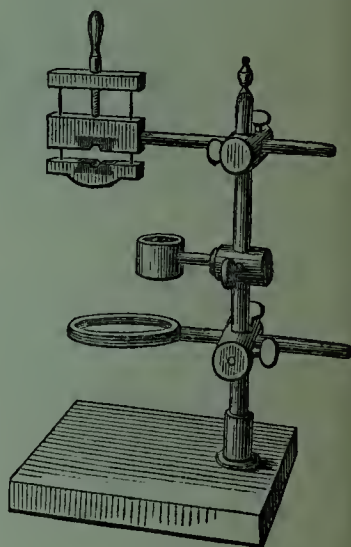
324. Gay-Lussac's Vice for supporting Tubes, Retorts, &c., Fig. 324, 2s. 6d.

325. Gahn's Cylinder Holder, for experiments with gases, Fig. 325, 2s. 6d.

326. Berzelius's Funnel Ring, Fig. 326, 1s. 6d.

327. The Set of Universal Supports, in polished mahogany, very elegant and substantial, 18s.

328. Universal Support, consisting of a rod and foot, with table branch, funnel-holder, and Sefstroem's retort-holder, Fig. 328, stained and polished wood, 7s. 6d.



328.

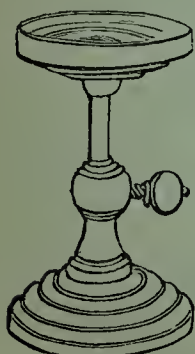
PEDESTAL TABLE SUPPORTS.

The Nos. 262 and 328 are examples of Table Supports attached to vertical rods. In this case, we have tables resting on pillars. They serve for the support of lamps and gas-burners, and the adjustment of parts of apparatus. They have all sliding rods by which the height can be regulated. See Figures 311, *d, e*; 329; 330; 333.

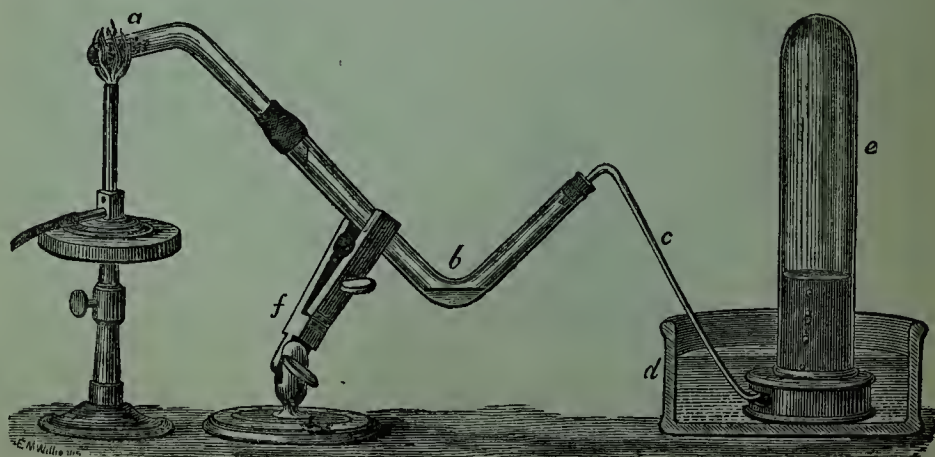
Mahogany Table Supports, elegant pattern, solid wood, with loaded foot, all French polished :—

329. Table, 3 inches, to rise from 5 inches to 8 inches, 2s. 6d.

330. Table, 4 inches, to rise from 7 inches to 12 inches, 3s. 6d.



329.

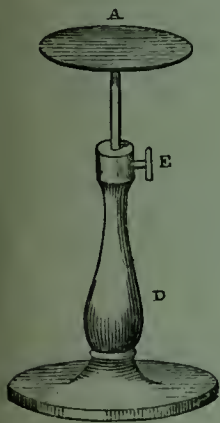


330.

331. Table, 5 inches, to rise from 9 to 14 inches, 4s.
 332. Table, 6 inches, to rise from 12 to 18 inches, 6s.
 333. Berzelius's Table Support, polished black wood, consisting of a sliding rod, foot, and table, 4 inches diameter, upon which a lamp or small furnace can be raised and firmly supported at any height from 12 to 18 inches above the surface of the work-table, Fig. 333; with a Crook to support tubes, Fig. 335, and a Tripod for globes, basins, &c., Fig. 334. Price 4s.
 336. Strong Table Support, for Water Bottles, &c., white wood, 7-inch top, to rise from 17 inches to 27 inches, 6s.

CROOK SUPPORTS FOR TUBES.

337. Crook, or Support, for Tubes which require to be held horizontally at any height between 6 and 10 inches from the table, consisting of two brass crooks, with a black wood foot and stem, with screw, Fig. 337. The set, 1s. 6d.



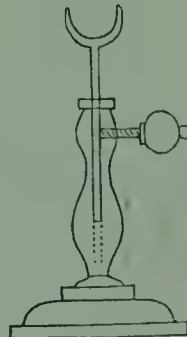
333.



334.



335.



337.



338.



340.

338. Mahogany Sliding Crook Support, round foot 5 inches diameter, rod 14 inches by $\frac{5}{8}$ inch, with sliding block and crook, Fig. 338, 2s.
 339. Black wood Sliding Crook, same size and pattern as the last, Fig. 338, 1s. 8d.
 340. Crook of the pattern of Figure 340, one pedestal with two crooks, to rise from 6 to 10 inches, both of black wood, 2s.
 341 Ditto, ditto, polished mahogany, 2s. 6d.

FUNNEL HOLDERS.

Wooden Funnel Holders, consisting of a Foot, Rod, and Funnel Ring, which can be fixed at any height by a collar and thumb-screw. All of polished mahogany with boxwood screws, or of polished hard black wood, Figs. 342, 343, 346.

SMALL SIZE, for *Funnels of 1½ to 4 inches diameter.*

- | | |
|--|--|
| 342. For one Funnel, black wood, 1s. | 345. For two Funnels, mahogany, 3s. |
| 343. For two Funnels, ditto, 2s. | 346. For four Funnels, black wood, 3s. 6d. |
| 344. For one Funnel, mahogany, 1s. 6d. | 347. For four Funnels, mahogany, 4s. 6d. |

LARGE SIZE, for *Funnels above 3 inches diameter.*

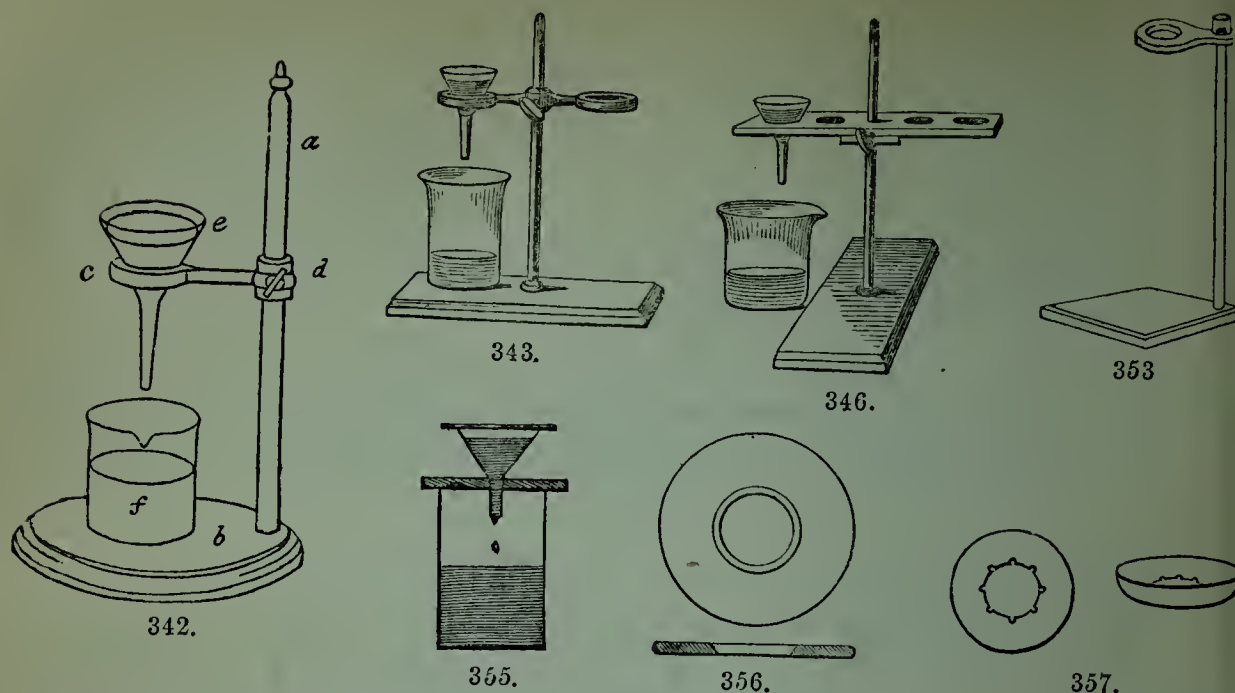
348. For one Funnel, black wood, 3s. 6d.
 349. For two Funnels, ditto, 4s. 6d.
 350. For one Funnel, mahogany, 5s.
 351. For two Funnels, ditto, 6s.
 352. For one Funnel, ditto, extra large foot, 6s. 6d.

353. Funnel Holder, polished black wooden rod and foot, with a glazed earthenware arm, similar to Fig. F, fixed by a screw, Figs. 353 and 353a, 9d.

For some purposes, the ring F can be used to hold the filter without a funnel.



353.



Funnel Holders in the form of perforated Circular Glass Discs, which serve also as covers for the Solution Jars, to keep out dust, &c., as shown in Figs. 355, 356.

355. Glass Discs, thick sheet Glass, with 1-inch hole in the centre.
4-inch disc, 1s.—5-inch disc, 1s. 2d.—6-inch disc, 1s. 4d.

357. Thuringian Porcelain Funnel Holders, circular, slightly concave, with a funnel hole in the centre. with serrated edges, Fig. 357.
No. 1. $7\frac{1}{2}$ inch, 1s. 6d. No. 2. $5\frac{1}{2}$ inch, 1s. 3d.

SUPPORTS FOR TEST TUBES.

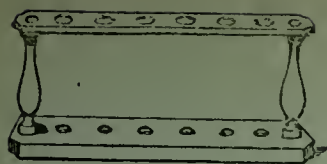
The following Tube Frames are made of sizes to support the tubes that are commonly used for testing liquids. These tubes are usually 4, 5, 6, or 7 inches long and $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, or $\frac{7}{8}$ inch in diameter; and, as a general rule, the frames are constructed to support tubes of those sizes. In some of the smaller frames two holes are made larger than the others, to receive tubes suitable for submitting the liquors to boiling.

A. Frames for Sets of Tubes, with Holes without Pegs.

- 358. For 6 Tubes of one size, white wood, Fig. 358, 5d.
- 359. For 6 Tubes of two sizes, white wood, Fig. 359, 5d.
- 360. For 12 Tubes, one row, white wood, 1s. 4d.
- 361. For 24 Tubes, in two rows, white wood, Fig. 361, 2s.
- 362. For 24 Tubes, in two rows, mahogany, Fig. 361, 5s.
- 363. For 12 Tubes, in two stages, stained wood, plan of Fig. 364, 2s.
- 364. For 19 Tubes, in two stages, stained wood, Fig. 364, 2s. 6d.
- 365. For 24 Tubes, in two stages, stained wood, Fig. 364, 4s.
- 366. Portable Test Tube Frame, for travelling mineralogists, japanned tinfoil, $4\frac{1}{2}$ inch long, holds 6 tubes of $\frac{1}{2}$ inch diameter, folds up flat by means of 4 hinges, Fig. 366, 10d.
- 367. Another, similar, 9 inches long, for 6 tubes of 1 inch diameter, 2s.

B. Frames for Test Tubes, having both Holes and Draining Pegs.

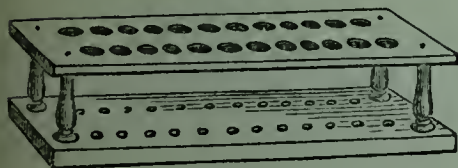
- 368. For 6 Tubes, of $1\frac{1}{4}$ inch diameter, white wood and white wood pegs, 1s. 2d.
- 369. For 6 Tubes, of $1\frac{1}{4}$ inch diameter, black wood and stoneware pegs, 2s.
- 370. For 4 Tubes, of $\frac{7}{8}$ inch diameter, black wood and stoneware pegs, 1s.
- 371. For 8 Tubes, white wood and white wood pegs, 1s. 2d.
- 372. For 8 Tubes, black wood and stoneware pegs, Figs. 372, 373, 2s.



358.



359.



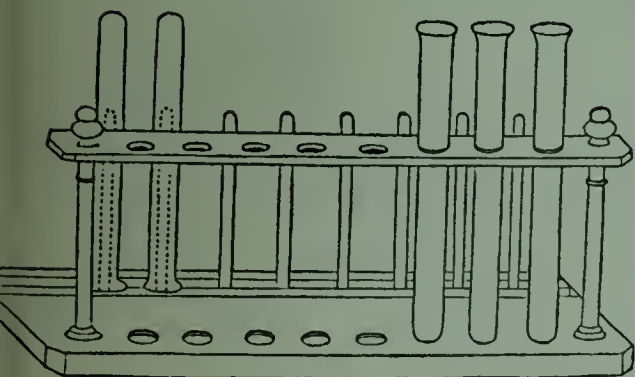
361.



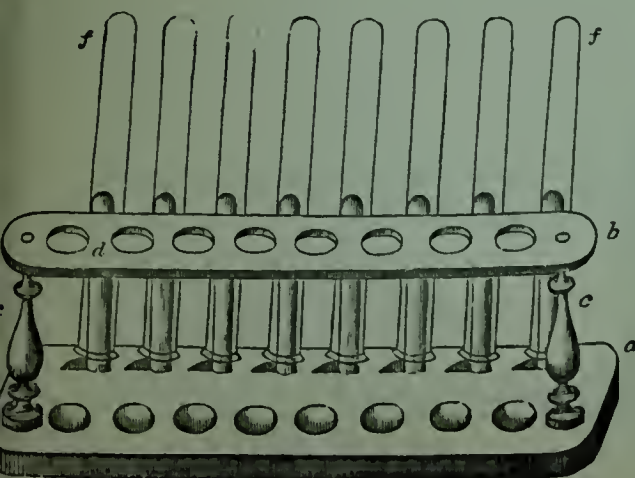
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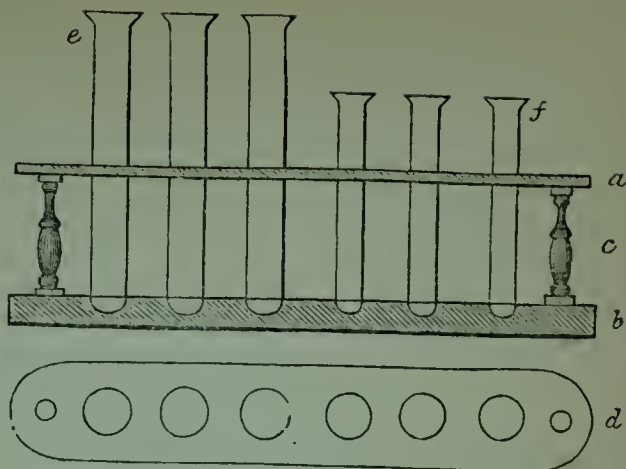
366.



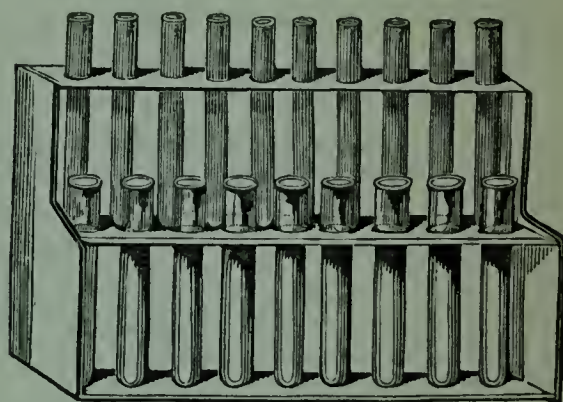
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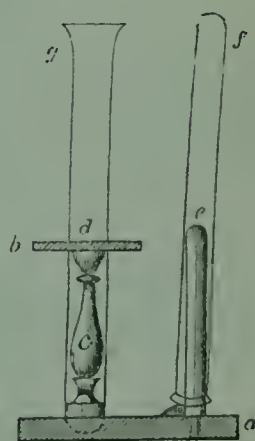
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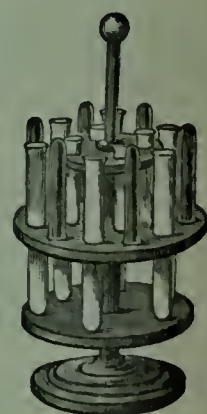
359.



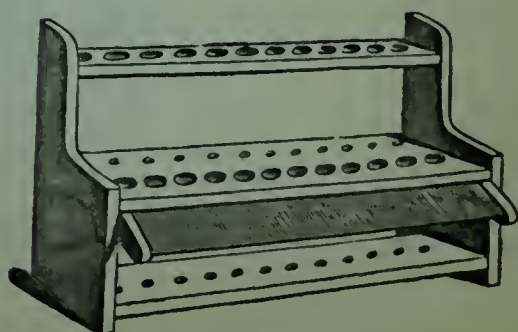
364.



373.



376.



360.

374. For 12 Tubes, black wood and stoneware pegs, 2s. 6d.

375. For 12 Tubes, white wood, wooden pegs, 1s. 8d.

376. Revolving Vertical Tube Stand, with two moveable stages, containing 13 holes and 7 pegs, Fig. 376, in polished black wood, 6s.

377. The same, in polished mahogany, 7s. 6d.

C. Supports for Test Tubes, with Slate Scales on which to mark the Names of the Tests tried.

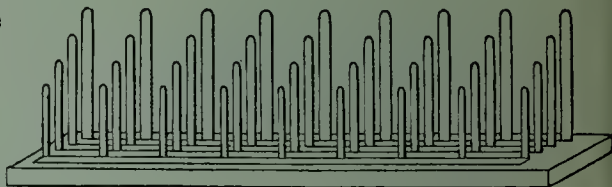
378. Support, with slate scale, for 9 tubes, stained wood, 3s.

379. Support, with slate scale, for 12 tubes, in one row, stained wood, 3s. 6d.

380. Support, with slate scale, for 24 tubes, in two rows, Fig. 380, stained wood, 5s.

D.—Frames for Test Tubes, with Pegs only.

385. Stock Rack for Tubes, consisting of 36 glazed stoneware pegs of three different sizes, adapted to tubes of 2 to 6 inches long, fixed on a polished black wooden base, 3s.



The stoneware pegs are intended for draining the test tubes after they have been washed, and preserving them from dust, so as always to be ready for use. The frames in classes A, B, C are most generally useful in testing. The stock rack is intended to hold a supply of tubes on a side shelf in the laboratory.

E.—Supports for Hot Test Tubes.

Tube Clips for holding a single test tube when hot:—

386. Wooden Clip, 6d.

387. Brass Wire Clip, with handle, 6d.

388. Spring Brass Clip, with handle, 10d.

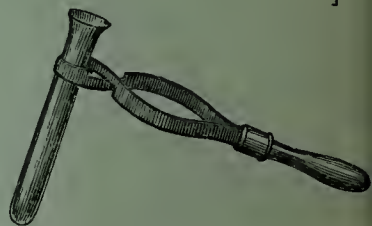
389. Spring Steel Clip, with handle, 1s. 3d.



386.



387.

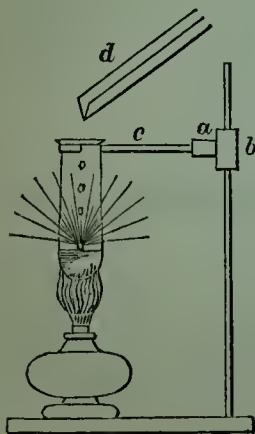


388, 389.

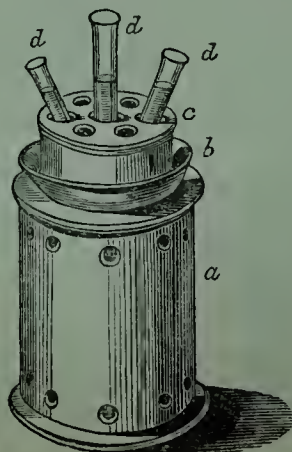
390. Brass Clip, with a collar and thumb-screw to fix it to the vertical rod of a retort stand. See No. 292.

391. Crook, with rod and foot, for supporting a test tube vertically over a spirit lamp or gas light, Fig. 391, 1s. 6d.

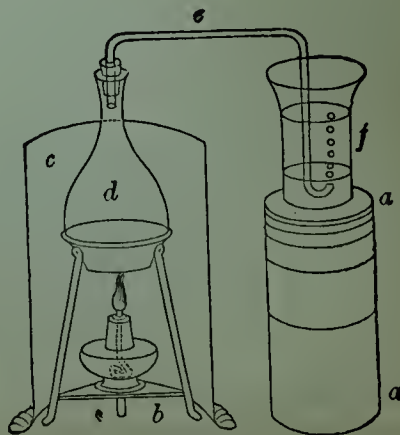
This crook is a modification of the tube-holder No. 293.



391.



392.



393.

92. Support for Test Tubes over a sand bath, Fig. 392; consisting of a stoneware apparatus which supports seven tubes. (In the Figure, *a* is the cylinder which surrounds the lamp; *b*, the sand bath; *c*, the tube support). 6d.

MISCELLANEOUS SUPPORTS.

BLOCK SUPPORTS:—

93. Set of Six round Wooden Blocks, for supporting and adjusting the heights of apparatus, 4 inches diameter, and $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2 and 4 inches high, Fig. 393 *a a*, the set, 1s. 3d.
94. The same in mahogany, 2s. 6d.
95. Sets of Five round Blocks, of $\frac{1}{2}$, 1, 2, 3, 5, inches thick. 5-inch diameter, 3s. 6d.—6-inch, 5s.—7-inch, 6s.—8-inch, 7s.

Condenser Supports: see article "Distillation."

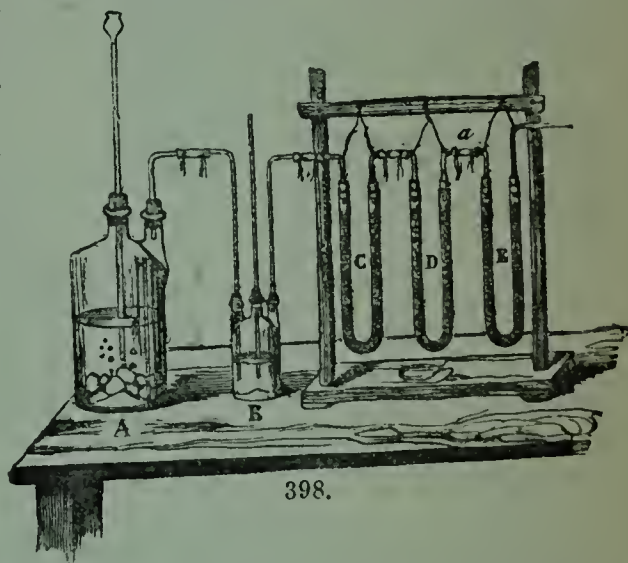
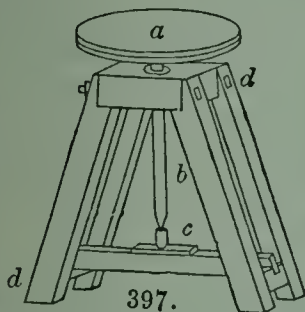
Pouret Supports: see article "Centigrade Testing."

Stoneware Support for Furnaces on a Table: see "Furnaces, Stoneware."

396. Gahn's Hand, recommended by Berzelius, for lifting small pans, &c. that have a flat handle, box-wood, 4s.

397. Whirling Table, useful in exhibiting models and other heavy apparatus at a Lecture, or in Museums, Fig. 397, 31s. 6d.

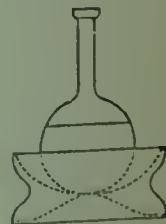
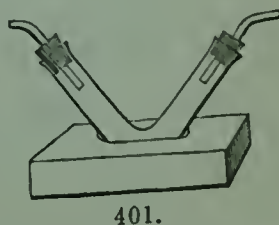
d d represents a strong wooden frame, spreading 18 inches by 27 on the floor; *a* is a table 2 inches thick and 21 inches diameter, attached to an iron frame and supported by a strong iron spindle, *b*, which works in the socket *c*, and is guided by a metal collar in the top of the frame, *d*. The surface of the table *a* is 30 inches from the floor. Models weighing more than 2 cwt. can be supported on this table, and turned about with the slightest touch, so as to be properly exhibited.



398. Support of Polished Black Wood for a series of Desiccating Tubes (U Tubes) with three hooks, Figure 398, *c*, *d*, *e*.

	Breadth.	Height.		
398.	13 inches,	11 inches.	For Three 6-inch U Tubes.	3s.
399.	12 inches,	16 inches.	For Three 9-inch U Tubes.	3s. 6d.
400.	15 inches,	18 inches.	For Three 12-inch U Tubes.	5s.

401. Support for V Tubes, black wood, 1s.
402. Cork Rings for supporting Flasks, Retorts, Basins, &c., 2-inch to 4-inch bore, each 2d.
403. Watch-glass Holders, iron wire, with handle, for use in heating a watch-glass, 6d.
404. Stoneware Support, to sustain Basins, Retorts, and other vessels with round bottoms, in an upright position when containing liquids, 9d.



405. Round Plates of Clay upon which to put Crucibles and other articles when hot, to protect the table, $\frac{1}{4}$ -inch or 1-inch thick, at the same price.
- | | | | | | | |
|---------|------------------------|---------|---------|---------|---------|-----------|
| 2-inch, | 2 $\frac{1}{4}$ -inch, | 3-inch, | 4-inch, | 6-inch, | 8-inch, | diameter. |
| 2d. | 2d. | 2d. | 3d. | 8d. | 1s. | each. |

Cylinders of Fireclay, for supporting Basins, Retorts, &c., on the table.

See the description of the Cylinders for setting up temporary gas furnaces, under the head of "Gas Burners," No. 1023.

Saltglazed Stoneware Cylinders. See the details of "Griffin's Lamp Furnace," No. 1191.

406. Wooden Stools, with round tops and three round legs, hard white wood.

1. 6-inch top, 10-inch legs, 1s. 4d.

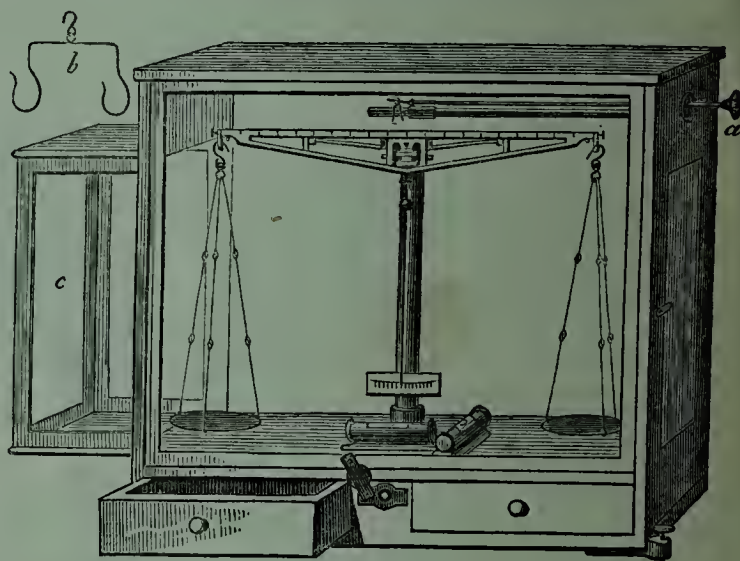
2. 8-inch top, 30-inch legs, 4s.

3. 6-inch top, 14-inch legs, with hole in the centre of the top, 2s. 6d.

Weighing and Measuring.

A.—BALANCES IN GLASS CASES.

407. Balance with 15-inch beam, with steel bearings, mounted as represented in Fig. 407, in mahogany glass case, with apparatus for moving a rider on the beam (a); a hook for supporting potash bulbs (b); a removable enlargement of the glass case (c); plated $2\frac{1}{2}$ -inch pans, hung by platinum links, and a contrivance for steadying the pans (omitted to be shown in the figure). The ends of the beam are formed as represented by Fig. 408; the pans being suspended by steel hooks resting on steel rings sharpened on the inner edge. £10.



407.

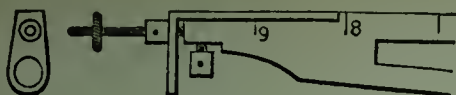
r 10.

Power.—Will carry 100 grammes, and show 1 milligramme; will carry 1,600 grains, and show $\frac{1}{10}$ grain. With 500 grains, it shows $\frac{1}{100}$ grain.

409. Balance, 15-inch beam, superior description. The ends of the beam are formed like Fig. 409. The upper part is graduated into ten divisions, and each division into fifths. The beam rests at its centre with agate planes on steel knife edges. The pans hang upon hooks like Fig. 410, which contain agate planes to rest on the steel knife edges at the ends of the beam. The two screws shown in Fig. 409 serve to justify the beam. The pans are steadied at the moment the beam is put into motion by a screw moved outside the balance case. There is a small mahogany stool and glass vessel with platinum wires for weighing substances in water. In the front of the glass case are two small doors to give access to the pans without lifting the front of the case. There are spirit levels and screws to put the case into horizontal position. £12 12s.

r 7.

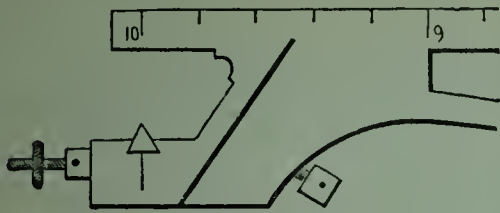
Power.—To carry 100 grammes, and indicate $\frac{1}{2}$ milligramme. With 1,600 grains, to show $\frac{1}{300}$ grain.



408.



410.



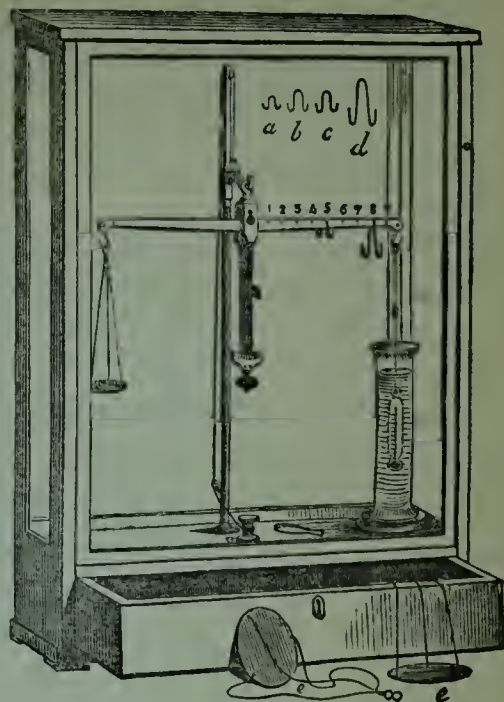
409.



410.



413.



421.

411. Balance of the best quality, like No. 409, and fitted in a mahogany glass case in the same style, but made of greater size and power, the beam being 18 inches long, divided into ten parts, and each tenth into halves. £16 16s. *r* 4.

Power.—To carry 500 grammes in each pan, and turn with a milligramme; that is to say, when loaded with above 1 lb. avoirdupois in each pan, it will show less than $\frac{1}{50}$ grain.

412. Balance with 12 $\frac{1}{2}$ -inch beam, fitted in mahogany glass case, as represented by Fig. 407, and agreeing with the description given of No. 407, £7 7s. *r* 17.

Power.—Will carry 50 grammes, and show 1 milligramme. With care, it may be weighted to 1,000 grains, and will show $\frac{1}{50}$ grain. With 500 grains, it shows $\frac{1}{100}$ grain.

413. Balance with 12 $\frac{1}{2}$ -inch beam of superior quality, fitted in a mahogany glass case; the ends of the beam made as shown in Fig. 413; the beam and pans resting on agate planes; the beam divided into ten parts, nine of which are marked upon it; the pans supported on hooks, like Fig. 410, as described at No. 409. £9 9s. *r* 15.

Power.—Will carry 50 grammes, and show $\frac{1}{2}$ milligramme. With care, will carry 1,000 grains, and show $\frac{1}{100}$ grain. With 500 grains, it shows $\frac{1}{500}$ grain.

414. Balance with 12 $\frac{1}{2}$ -inch beam, in mahogany glass case, of the same fine quality, and fitted upon the same style as the 15-inch beam No. 409, £10 10s. *r* 14.

Power.—To carry 50 grammes, and show $\frac{1}{2}$ milligramme. To carry 1000 grains, and show $\frac{1}{500}$ grain. With 500 grains, will show $\frac{1}{500}$ grain.

415. Balance for delicate weighings, to carry 50 grammes (or 800 grains) in each pan, and turn with $\frac{1}{10}$ milligramme ($\frac{1}{1000}$ of a grain); 12 $\frac{1}{2}$ -inch beam; the pans hanging on agate, and the beam working on agate, in a mahogany glass case, with fittings complete for chemical use. £15 15s. *r* 13.

416. Balance with 8-inch beam, mounted on a mahogany box, with a mahogany glass case, £3 6s. *r* 27.

Power.—To carry 500 grains, and to turn with $\frac{1}{50}$ grain. With 20 grammes, to show 1 milligramme.

417. Balance with 9-inch beam, mounted on a mahogany box, with a mahogany glass case, £4. *r* 25.

Power.—To carry 500 grains, and turn with $\frac{1}{50}$ grain. Will carry 30 grammes, and show 1 milligramme. With 300 grains, it shows $\frac{1}{100}$ grain.

418. Assay Balance for the accurate weighing of very small quantities, described as No. 434, in a mahogany glass case, from which it can be removed in a portable box, the glass case being folded up for readier transport, £3 3s. r 30
419. Assay Balance for weighing gold and silver beads, 10-inch beam, in mahogany glass case, £8 8s. r 20

Power.—Will carry 160 grains, and show $\frac{1}{500}$ grain. Will carry 10 grammes, and show $\frac{1}{10}$ milligramme.

420. Assay Balance, on Makins's plan, suitable for rapid action; 10-inch beam either of steel or aluminium; double-pillar stand; pans suspended on agate beam divided for rider; in mahogany glass case, with plate-glass bottom £28.

Power.—When loaded with 30 grains in each pan, will distinctly turn with $\frac{1}{5000}$ th of a grain.

421. Mohr's Balance for taking the specific gravities of liquids by an easy method which gives the specific gravity without calculation, and requires but a small quantity of liquid, and no other apparatus than is represented on Fig. 421
421. Price in mahogany glass case, including a portable mahogany box, 84s.
422. Ditto in a mahogany box without glass case, 50s.
423. The essential Apparatus,—namely, beam, plummet, set of riders, and a simple support,—without the mahogany box and extra fittings, 25s.

Description of Mohr's Specific Gravity Balance.—This apparatus consists of the articles represented in Fig. 421; namely, a 10-inch beam, of which one branch is divided into ten parts; a glass plummet, which contains a thermometer, and is attached to a platinum wire by which it can be suspended from the beam; a glass cylinder, and a mahogany tray for it; a small brass pan to counterpoise the plummet; a pair of pans, marked *ee* in the figure, for the ordinary weighing of solid bodies; a set of riders, marked *a b c d*, of which *d* is equal to the weight of the water displaced by the plummet, while *c* = $\frac{1}{10}$ of *d*, *b* = $\frac{1}{10}$ of *c*, and *a* = $\frac{1}{10}$ of *b*. The apparatus can be dismounted and packed in the mahogany box, and then removed from the glass case for travelling.

The scale of the thermometer included in the glass plummet is usually that of Reaumur, for which reason I give the following equivalents of the degrees most likely to be observed:—

R.	F.	R.	F.	R.	F.	R.	F.
20°	77°	16°	68°	12°	59°	8°	50°
19	74·75	15	67·75	11	56·75	7	47·75
18	72·5	14	63·5	10	54·5	6	45·5
17	70·25	13	61·25	9	52·25	5	43·25

Process.—1. When the small pan is attached to one end of the beam and the plummet to the other end, the beam rests in equilibrium. 2. If the plummet is plunged into distilled water, the end of the beam rises. 3. If in that case one of the largest riders, *d*, is put on the hook at the same end of the beam, the equilibrium is again restored. This result shows that the rider *d* is equal in weight to the displacement of the plummet.

4. If a liquid lighter than water is submitted to trial, the large rider *d* must be placed somewhere on the divided branch of the beam, where it will produce equilibrium. But when, as commonly happens, this occurs at some point between two notches on the beam, it is best to rest the rider on the notch of lowest value of the two between which it rests, and then to apply the next sized rider, *c*, to determine the difference. Thus, in Fig. 421, we see the large rider at 8, and the small rider at 5. In this case, the former represents 8 in the first place of decimals, and the latter represents 5 in the second place of decimals. Thus, 0·85. If the rider *c* does not effect an equilibrium, when fixed in a notch, but falls between 4 and 5, then it must be placed in 4, and the third-sized rider, *b*, must be employed to find the exact point of equilibrium. This third size of rider stands for the third place of decimals in the expression of the specific gravity; and finally, the smallest rider, *a*, expresses the fourth place of decimals, thus:—

<i>a</i> is = ·0001 to ·0009	} According as they stand in the notches 1 to 9 on the beam when at rest.
<i>b</i> is = ·001 to ·009	
<i>c</i> is = ·01 to ·09	
<i>d</i> is = ·1 to ·9	

5. If a liquid heavier than water is tried, the process goes on exactly as above described, with the addition that one of the riders *d* is in every case hung at 10, the extreme end of the beam, to serve as the equivalent of the weight of water, while the riders which show the difference between water

and the given heavy liquid cross the beam at the proper points. A few examples will illustrate this principle. In the following plans, the figures represent the notches on the beams, and the letters the respective sizes of riders :—

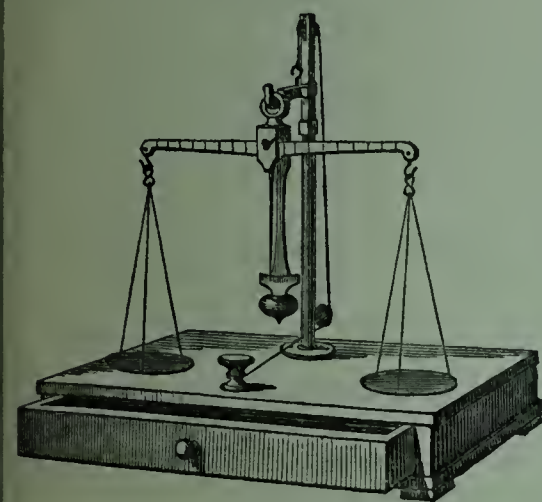
1	2	3	4	5	6	7	8	9	10	
	b		c				d			$d = 1.842$ Sulphuric Acid.
		dc								$d = 1.33$ Caustic Potash.
				c				d		$= 0.96$ Ammonia.
					d					$= 0.75$ Ether.
		d	b					c	d	$= 1.495$ Nitric Acid.

Power of the Balance to weigh Solids.—It will carry 1000 grains, and show $\frac{1}{10}$ grain. With 500 grains, it shows $\frac{1}{20}$ grain; and with 300 grains, it shows $\frac{1}{30}$ to $\frac{1}{50}$ grain.

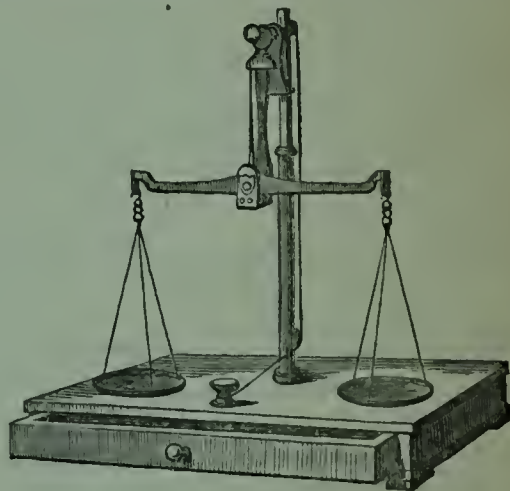
B.—BALANCES IN MAHOGANY BOXES.

These are furnished with supports that screw into the top of the Boxes, as represented by the different figures, and pack inside the boxes for travelling.

The four Balances No. 424 to No. 427 are made of the form represented by Fig. 424. The beams and pans are of brass, and the pans hung with silk cord; the boxes, of polished mahogany.



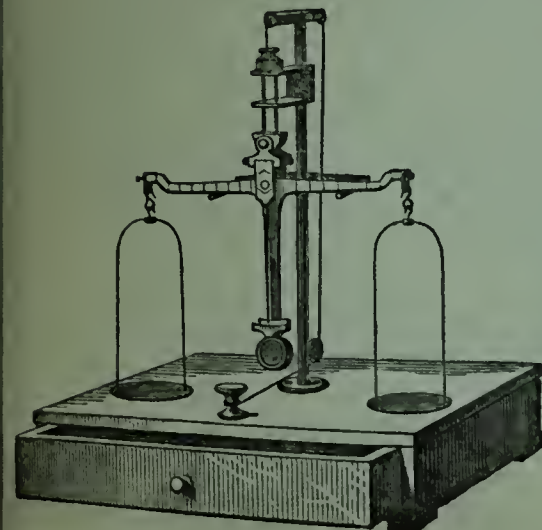
424.



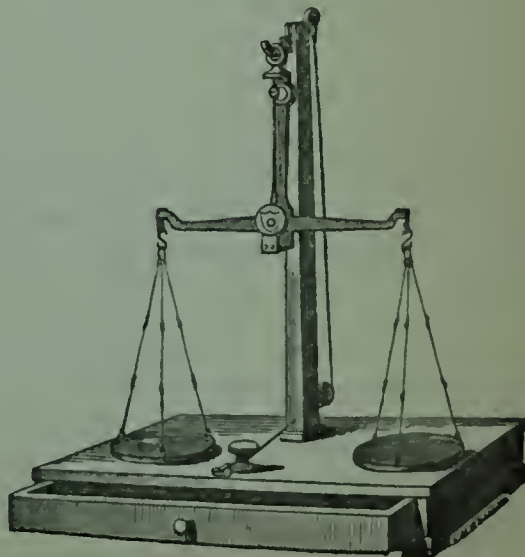
428.



429.



430.



431.

424. Balance with beam 8 inches long; pans 2 inches wide; box $11\frac{1}{4}$ inches long, $5\frac{1}{2}$ inches wide, $2\frac{1}{4}$ inches deep. 31s. 6d. r 4

Power.—Will carry 800 grains, and show $\frac{1}{20}$ grain. With 500 grains, it shows $\frac{1}{30}$ grain.

425. Balance with beam 10 inches long; pans $2\frac{1}{2}$ inches wide; box $12\frac{1}{2}$ inches long, $6\frac{3}{8}$ inches wide, $2\frac{1}{8}$ inches deep. 36s. r 4

Power.—Will carry 1,000 grains, and show $\frac{1}{20}$ grain. When loaded with 500 grains, it shows $\frac{1}{30}$ grain.

426. Balance with beam $10\frac{1}{2}$ inches long; pans $2\frac{1}{2}$ inches wide; box $13\frac{1}{2}$ inches long, $6\frac{1}{2}$ inches wide, $2\frac{1}{2}$ inches deep. 38s. r 3

Power.—Will carry 4 ounces, and show $\frac{1}{30}$ grain. With 1,000 grains, it shows $\frac{1}{30}$ grain.

427. Balance with beam $11\frac{1}{2}$ inches long; pans 3 inches wide; box 15 inches long, 7 inches wide, $2\frac{3}{8}$ inches deep. 42s. r 3

Power.—Will carry 6 ounces, and show $\frac{1}{10}$ grain. With 1,000 grains, it shows $\frac{1}{20}$ grain. With 500 grains, it shows $\frac{1}{30}$ grain.

428. Balance with $8\frac{1}{2}$ -inch beam; $2\frac{3}{4}$ -inch pans, with silk strings; mahogany box $13\frac{1}{2}$ inches long, $6\frac{1}{2}$ inches wide, $2\frac{1}{2}$ inches deep; fitted up as represented by Fig. 428. 45s. r 3

Power.—Will carry 8 ounces, and show $\frac{1}{10}$ grain. With 1,000 grains, it shows $\frac{1}{20}$ grain. With 500 grains, it shows $\frac{1}{30}$ grain.

429. Balance resembling No. 424, excepting that the beam is slight, and of the form of Fig. 429. Length of beam $8\frac{1}{2}$ inches; pans $2\frac{1}{4}$ inches, hung with silk cords; box $11\frac{1}{4}$ inches long, $5\frac{1}{4}$ inches wide, $2\frac{1}{2}$ inches deep. 35s. r 4

Power.—Will carry 500 grains, and show $\frac{1}{30}$ grain. With 25 grammes, it turns with 1 milligramme.

430. Balance with $9\frac{1}{2}$ -inch divided beam; $2\frac{1}{2}$ -inch brass pans; mahogany box 14 inches long, $7\frac{1}{2}$ inches wide, 4 inches deep; fitted up as represented by Fig. 430. 55s. r 3

Power.—Will carry 8 ounces, and show $\frac{1}{20}$ grain. With 1,000 grains, it shows $\frac{1}{30}$ grain.

431. Balance, $9\frac{1}{2}$ -inch beam; 3-inch pans, suspended by brass links; square mahogany pillar $12\frac{1}{2}$ inches high; mahogany box $13\frac{1}{2}$ inches long, $6\frac{3}{4}$ inches wide, $2\frac{1}{2}$ inches deep. The pillar does not pack into the box. 35s. r 4

Power.—Will carry 8 ounces, and show $\frac{1}{5}$ grain. With 1,000 grains, it shows $\frac{1}{10}$ grain.

432. Balance with $8\frac{1}{2}$ -inch beam; 3-inch pans, with silk cord; mahogany box $13\frac{1}{2}$ inches long, $6\frac{3}{4}$ inches wide, $2\frac{1}{2}$ inches deep. This Balance has a beam like that of 431, but is fitted with a brass support that packs in the box like No. 424. 40s. r 4

Power.—Will carry 8 ounces, and show $\frac{1}{20}$ grain. With 1,000 grains, it shows $\frac{1}{30}$ grain.

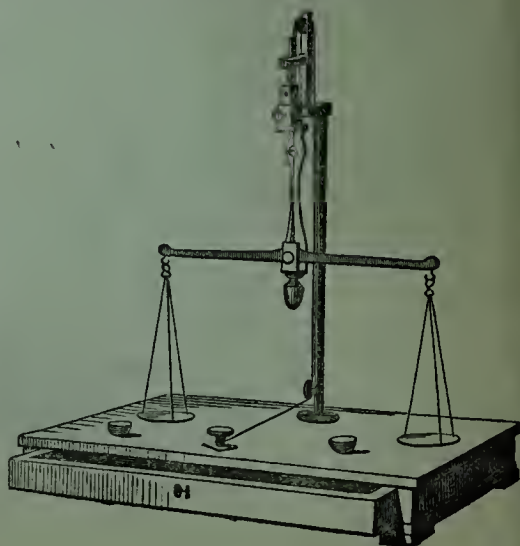
433. Balance similar to the above (No. 431), with 13-inch beam; $4\frac{1}{2}$ -inch pans, with brass links; mahogany box 15 inches long, $9\frac{1}{2}$ inches wide, $2\frac{1}{2}$ inches deep; mahogany pillar support. 50s. J 298 c.

Power.—Will carry 1 lb. and show $\frac{1}{2}$ grain. With $\frac{1}{2}$ lb. shows $\frac{1}{5}$ to $\frac{1}{10}$ grain.

434. Assay Balance for weighing gold and silver in small quantities; beam $6\frac{1}{2}$ inches long; pans $1\frac{1}{4}$ inches wide, with extra $\frac{3}{4}$ -inch cups. Packs into a polished mahogany box, $10\frac{1}{2}$ inches long, $5\frac{3}{4}$ inches wide, $2\frac{1}{4}$ inches deep. 50s. r 29.

Power.—Will carry 20 grains, and show $\frac{1}{600}$ grain. With 10 grains it shows $\frac{1}{1000}$ grain.

This Balance is also supplied with a portable folding glass case: see No. 418.



35. Plattner's Balance, for the accurate determination of very small weights, used as part of his portable collection of apparatus for the quantitative assay of gold, silver, ores of copper, lead, &c., by the blowpipe. Length of beam $6\frac{1}{2}$ inches; power to carry 1 gramme, and show $\frac{1}{10}$ milligramme: that is to say, to carry 15 grains, and turn with $\frac{1}{600}$ th of a grain. With a set of gramme weights. The whole arranged in cavities, cut in two boards that are hinged together, and form, when shut up, a base for the support of the balance. £4. r 21.
36. Balance with a brass beam 12 inches long, in a mahogany box, with a support adapted to the top of the box. The pans rest on the box, and are moved by a lever. Will carry 1,000 grains in each pan, and turn with $\frac{1}{100}$ grain: with 300 grains, it shows $\frac{1}{100}$ grain. The beam is divided into ten parts from the fulcrum to the end, for a rider. With a set of weights from 500 grains to $\frac{1}{100}$ grain. £5 15s. 6d. r 33.

COMMERCIAL BALANCES.

37. Apothecaries' Scales and Weights, to weigh quantities up to half an ounce, in plain oak box, with set of weights, 2s. 6d.
38. Ditto, superior, with glass pans, in oak box, 6s.
39. Ditto, superior, with box-end beam, and glass pans, in mahogany box, 8s. 6d.
40. Ditto with ivory pans, 12s.
41. Balance to carry 1 lb. and turn with 1 grain, 10-inch beam, 5-inch brass pans in oak box, 18s.

C.—WEIGHTS.

45. Grain Weights. Set of accurate weights, consisting of 600, 300, 200, 100, 60, 30, 20, 10 grains in brass, and 6, 3, 2, 1, .6, .3, .2, .1, .06, .03, .02, .01 grain, in platinum; in a mahogany box, with tongs. 25s.
46. Grain Weights, accurate, from 1,000 grains to .01 grain, in a mahogany box, with tongs, 31s. 6d.
47. Grain Weights, less accurate, from 600 grains to $\frac{1}{10}$ grain, in a box, 16s.
48. Another set, less accurate, 600, 300, 200, 100, 60, 30, 20 grains, in brass, with knobs; and 10, 6, 3, 2, 1, $\frac{1}{2}$ grains, in brass foil, without box. 8s.
49. Ditto, in a wooden case, 10s. 6d.
50. Smaller set, 100, 50, 30, 20, 10, 6, 5, 4, 3, 2, 1, and $\frac{1}{2}$ grains, in brass, without a case, 4s.
51. Grain Weights and Decimal Fractions, in platinum; namely, 6, 3, 2, 1; .6, .3, .2, .1; .06, .03, .02, .01. The set, 10s. 6d.
52. Set of Grains, 6, 3, 2, 1, in a box, 7s.
53. Set of Tenths, .6, .3, .2, .1, in a box, 3s.
54. Set of Hundredths, .06, .03, .02, .01, in a box, 3s.
55. Standard Gramme Weights, according to Mohr, justified according to the Platinum Kilogramme of Dr. Schumacher in Altona. The weights made of German silver, in the following series—50, 20, 10, 10, 5, 2, 1, 1, 1, .05, .02, .01, .01, .005, .002, .001, .001; with three gilt riders, and ivory tongs, in mahogany box. 25s.
56. Gramme Weights, accurate, 50 grammes to 10 grammes, in brass, and .5 to .001 grammes, in platinum, in a mahogany box, with tongs, 31s. 6d.
57. Gramme Weights, containing the series, 100, 50, 20, 10, 10, 5, 2, 1, 1, 1, in brass, and .5, .2, .1, .1, .05, .02, .01, .005, .002, .002, .001, .001, in platinum, with four riders, and tongs, in a mahogany box, 36s.
58. Gramme Weights, containing the series 500, 200, 100, 100, 50, 20, 10, 10, 5, 2, 1, 1, 1, in albata, and .5, .2, .1, .1, .05, .02, .01, .01, .005, .002, .001, in platinum, with four riders, ivory tongs, and two weight-lifters, in a mahogany box, 50s.

459. Pound Pile of Avoirdupois Weights in brass, round and flat, adjusted, consisting of 1 lb., $\frac{1}{2}$ lb., $\frac{1}{4}$ lb., 2, 1, and $\frac{1}{2}$ oz., 5s.
460. Pound Pile of Avoirdupois Weights, cast-iron, round and flat; set of 7 weights adjusted, 1 lb., $\frac{1}{2}$ lb., $\frac{1}{4}$ lb., 2 oz., 1 oz., $\frac{1}{2}$ oz., and $\frac{1}{4}$ oz., the two last of brass Per set, 1s. 6d.
461. Square Iron Weights, with handles, Fig. 461, 14 lb., 2s.; 28 lb., 4s.; 65 lb., 8s.
462. Set of Apothecaries' Grain Weights, 2 drachms to $\frac{1}{2}$ grain; viz., 2, 1, $\frac{1}{2}$ dr.; 2, 1, $\frac{1}{2}$ scruples; 6, 5, 4, 3, 2, 1, $\frac{1}{2}$ grains. 1s.
463. Riders to slide on the balance beam, Fig. 463.
A. English, $\frac{1}{10}$ grain. 4d. | B. French, 1 centigramme. 4d.
464. Assay Weights for Gold, $\frac{1}{2}$ gramme being = 1000, with its subdivisions. 30s.
465. Assay Weights for Silver, 1 gramme being = 1000, with its subdivisions. 30s.



461.



463.



467.

466. Balance Pans, of glazed Berlin porcelain, for weighing corrosive substances.
Price per pair—
 $1\frac{1}{2}$ inch, 1s. 2 inch, 1s. 3d. $2\frac{1}{2}$ inch, 1s. 6d. $8\frac{1}{2}$ inch, 5s.
467. Weight Lifter, for lifting knobbed weights, Fig. 467, brass or zinc, 3d.
468. Ivory Tongs for lifting weights, 1s. Better, 3s.
469. Brass Tongs for lifting weights, 9d. Better, 2s.

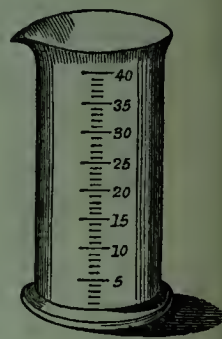
D.—GRADUATED LIQUID MEASURES.

These Measures are graduated with the same degree of care as the measures for Volumetric Analysis, and may be depended upon for accuracy. None are done by the common rough process with the glass-cutter's wheel. The graduation agrees with the bottom of the dark curve formed by the surface of the liquid.

CYLINDRICAL GLASS MEASURES, Fig. 475, graduated into IMPERIAL OUNCES of WATER.

60 minims to the drachm, 8 drachms to the ounce, 16 ounces to the pound, 20 ounces to the pint.

475. 1 Drachm, showing 12 spaces = 5 minims each. 1s.
476. 2 Drachms, showing 24 spaces = 5 minims. 1s. 3d.
477. 1 Ounce, showing 16 spaces = $\frac{1}{2}$ drachm. 9d.
478. 2 Ounces, showing 16 spaces = 1 drachm. 1s.
479. 5 Ounces, showing 20 spaces = $\frac{1}{4}$ ounce. 1s. 3d.
480. 10 Ounces, showing 20 spaces = $\frac{1}{2}$ ounce. 1s. 6d.
481. 20 Ounces, showing 40 spaces = $\frac{1}{2}$ ounce. 2s. 6d.
482. 40 Ounces, showing 40 spaces = 1 ounce. 3s. 6d.



475.

CYLINDRICAL GLASS MEASURES, graduated into Divisions of the LITRE, form of Figure 475. [1 litre = 1000 grammes].

483. 30 Grammes, showing 30 spaces = 1 gramme each. 1s.
484. 60 Grammes, showing 30 spaces = 2 grammes. 1s. 3d.
485. 150 Grammes, showing 30 spaces = 5 grammes. 1s. 6d.
486. 300 Grammes, showing 30 spaces = 10 grammes. 2s.
487. 600 Grammes, showing 30 spaces = 20 grammes. 3s.
488. 1200 Grammes, showing 60 spaces = 20 grammes. 4s.

For Graduated Bottles, Test Mixers, Pipettes, Burettes, &c, see the section on "Volumetric Analysis."

Thermometers for Chemical Use.

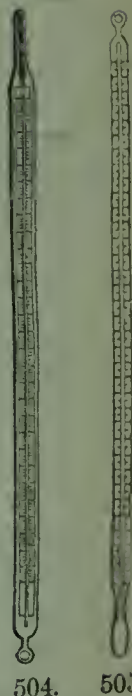
The scales of these Thermometers are either etched upon the glass tubes, or they are written on slips of paper or milk glass, which are entirely enclosed in glass tubes, without fittings of metal or wood, so that the instruments can be safely immersed in hot, caustic, or acid liquors.

The *lowest* point on the scales of these Thermometers is generally about 40° or 30° Fahrenheit. The *highest* point to which each ranges, as cited below, is approximate. It may range a few degrees above or under the quotation.

Thermometers with long scales (or wide spaces between the degrees) cost 1s. to 1s. 6d. extra.

Pasteboard Boxes for the Thermometers are included in the following prices :—

WITH FAHRENHEIT'S SCALE.		212°.	350°.	500° to 600°
501	Paper Scales, outer tube, $\frac{1}{2}$ to $\frac{5}{8}$ inch.	2s. 3d	3s.	4s.
502	Paper Scale, outer tube, $\frac{3}{8}$ in.	2s. 9d.	3s. 6d.	4s. 6d.
503	Milk-glass Scale, outer tube, $\frac{1}{2}$ to $\frac{5}{8}$ in.	3s. 6d.	4s.	5s. 6d.
504	Milk-glass Scale, outer tube, $\frac{3}{8}$ in.	4s.	5s.	6s.
505	Engraved on the Rod, $\frac{1}{4}$ to $\frac{3}{8}$ in.	4s.	5s.	6s.
506	Scale on Tube with white back, $\frac{3}{8}$ in.	4s. 6d.	5s. 6d.	6s. 6d.



The Thermometers Nos. 502, -4, and -5 have narrow cylindrical mercury vessels, to enable them to be passed through corks for insertion into Retorts, &c.

WITH CENTIGRADE SCALE.		100°.	200°.	360°.
507	Paper Scale	2s. 6d.	3s.	3s. 6d.
508	Milk-glass Scale	3s. 6d.	4s.	5s.
509	Scale engraved on the Tube	4s.	5s.	6s.
510	Scale on Tube with white back	4s. 6d.	5s. 6d.	6s. 6d.

The Thermometers Nos. 507 to 510 are all contained in Tubes of $\frac{1}{4}$ or $\frac{3}{8}$ inch diameter; and the mercury vessels are narrow and cylindrical, to permit the passage of the thermometer through corks for insertion into Retorts, &c.

511. Thermometers with Two Scales, Fahrenheit's and the Centigrade. At 1s. 6d. each beyond the price of those with Fahrenheit's scale only. Examples :—

- Paper Scale, 320° F. and 160° Cent., 4s. 6d.
- Milk-glass Scale, 320° F. and 160° Cent., 5s. 6d.

512. Thermometers for Precise Experiments, all with Centigrade Scales :—

- Small size, range from -10° to $+50^{\circ}$ C. by $\frac{1}{10}^{\circ}$ C., 15s.
- Ditto, ditto ditto, by $\frac{1}{20}^{\circ}$ C., 21s.
- Larger size, range from -10° to $+50^{\circ}$ C. by $\frac{1}{10}^{\circ}$ C., 14s.
- Ditto, ditto ditto, by $\frac{1}{20}^{\circ}$ C., 18s.

THERMOMETERS FOR CHEMICAL MANUFACTURERS.

- 513a. Brewers' and Distillers' Thermometer, in a rod with brass bands and safety frame, the scale on milk glass; length, 3 to 4 feet. 18s.
- 513b. Ditto, without the brass bands. 12s.
- 513c. Brewers' Thermometer; paper scale in glass cylinder, with wooden frame. 12 inch, 3s. 6d.—15 inch, 5s. 6d.—20 inch, 7s. 6d.
- 513d. Brewers' Thermometers, with silvered brass scale, fixed in black wood frame. 16 inch, 4s.—24 inch, 5s.—36 inch, 6s.
514. Varnish-Makers' Thermometer, 3 feet long, scale to 600° , in an iron case, with brass scale and safety frame, 35s.
- 514a. Hot-Blast Thermometer, with milk-glass scale to 600° F., for testing hot air at ironworks, 6s.
- 514b. Vinegar-Makers' Thermometer, scale to 120° F., 1s. 6d.
515. Very small and heavy Thermometer to sink in oil of vitriol, paper scale, 1s. 3d.
- 515a. Thermometer, small size, for taking temperatures in specific gravity bottles, with only three marks, 55° , 60° , 65° F., 1s. 6d.
516. DANIEL'S PYROMETER, for measuring high temperatures in furnaces, with a platinum bar, £6.

THERMOMETERS FOR PHYSICIANS.

517. These Thermometers are adapted for determining the temperature of the human body by application under the arm-pit, &c., of a patient confined to bed. The use is described by Professor WILLIAM AITKEN, in his work on *The Science and Practice of Medicine*, where the importance of detecting the approach of fever by thermometric observations is explained.

The Thermometers, Nos. 1 to 4, are under 8 inches long, and are made of stout glass tubes.

Nos. 5 and 6 are long Thermometers with extended scales.

1. Fahrenheit's Thermometer, with scale from 88° to 111° , every degree divided into $\frac{1}{2}$ ths, the scale on paper, 4s.
2. Ditto, the scale on glass, 6s.
3. Ditto, the scale on paper; the thermometer bent, to enable it to be applied close under the arm-pit, 5s.
- 3a. Ditto, the scale on glass, 7s.
4. Ditto, with a register to show the maximum temperature without reading the scale while the instrument is *in situ*; for use in cases of contagious fever.
5. Centigrade Thermometer, each degree in $\frac{1}{10}^{\circ}$, scale on milk glass, the tube $\frac{1}{4}$ or $\frac{3}{8}$ inch thick, 10s.
6. Ditto, scale divided into $\frac{1}{2}^{\circ}$, 7s. 6d.

THERMOMETERS FOR METEOROLOGICAL PURPOSES will be described in the Catalogue of "Apparatus for Experiments in Physics," in the section relating to HEAT.

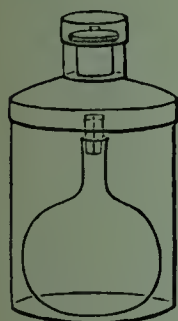
Apparatus for Determining the Specific Gravity of Liquids.

SPECIFIC GRAVITY BOTTLES.

DETERMINATION OF THE SPECIFIC GRAVITY OF LIQUIDS BY THE WEIGHING OF MEASURED QUANTITIES.

518. Specific Gravity Bottle, slight blown glass, with perforated stopper, in japanned tin case, with counterpoise, Fig. 518.

a. CONTENTS: 1000 grains, 5s. b, 500 grains, 4s. 6d. c, 250 grains, 4s. 6d.



518.



520.



520a.



521.



522.

519. Specific Gravity Bottle, carefully adjusted with ground stoppers, and counterpoise, in neat leather cases.

1. 100 grains	. 5s. 6d.	5. 10 grammes	. 5s. 6d.
2. 250 "	. 6s. 6d.	6. 20 "	. 6s. 6d.
3. 500 "	. 8s. 6d.	7. 25 "	. 7s. 6d.
4. 1000 "	. 10s. 6d.	8. 50 "	. 8s. 6d.
		9. 100 "	. 12s.

520. Specific Gravity Bottle, slight blown glass, with perforated stopper, without case or counterpoise, Fig. 520 and 520a.

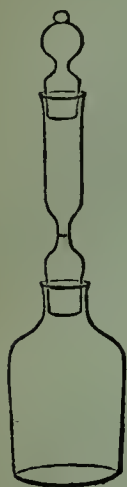
1. 100 grains	. 2s.	8. Not adjusted; about	
2. 250 "	. 2s. 6d.	1 cubic inch	. 6d.
3. 350 "	. 2s. 6d.	9. 10 grammes	. 2s.
4. 500 "	. 3s.	10. 20 "	. 2s. 6d.
5. 700 "	. 3s. 6d.	11. 25 "	. 2s. 6d.
6. 1000 "	. 7s.	12. 50 "	. 3s. 6d.
7. 1 cubic inch	. 1s. 3d.	13. 100 "	. 4s. 6d.

521. Specific Gravity Bottles, of stout glass, blown at the glass house, with solid stoppers, having a slit cut down the side; Fig. 521, at the same prices as the slight blown glass. No. 520.

522. Specific Gravity Bottle, on the plan recommended by Regnault, Fig. 522.
 250 grains, 2s. 6d. 500 grains, 3s. 1000 grains, 4s.
 25 grammes, 2s. 6d. 50 grammes, 3s.

In using this form of bottle, the liquor is filled in above the mark, the temperature is determined by inserting a thermometer, the liquor is adjusted to the mark by a pipette, or a fold of filter paper, and the stopper is then inserted.

523. Specific Gravity Bottle, with ground funnel and ground stopper, contents about half an ounce of water, Fig. 523, 2s.
 524. Specific Gravity Bottle, with thermometer stopper, Fig. 524, contents, 1000 grains, 7s. 6d.
 525. Ditto, with the Thermometer finely divided, 10s. 6d.



523.



524.



526.



527.



528a.

526. Specific Gravity Bottle, with thermometer stopper, Fig. 526.
a contents, 50 grammes, 6s.; *b* 100 grammes, 7s. 6d.
 527. Specific Gravity Bottle in the form of a Woulff's bottle, with two necks, one consisting of a long capped graduated tube, and the other containing a delicate thermometer, contents, 1 cubic inch, Fig. 527, 9s.
 528. Specific Gravity Bottles, of slight blown glass, with wide necks and perforated stoppers, for taking the specific gravity of solid bodies; capacity about half-ounce of water, not adjusted, Figs. 528a, 528b, each 6d.



528b.



530a.



530b.



531.

529. Specific Gravity Bottle, round form with hollow stopper; 1000 grains, adjusted, 4s. 6d.
 530. Specific Gravity Bottle, consisting of a slight flask with a narrow neck, having one mark to indicate the measure, Figs. 530a, 530b:—
 531. Specific Gravity Bottle, consisting of a slight flask with a narrow neck, having one mark to indicate the measure, and a solid stopper, which closes the flask but is not concerned in the regulation of the measure, Fig. 531:—

The prices of the Sp. Gr. Bottles, Nos. 530 and 531, will be found under the head of MEASURING FLASKS in the section on "Volumetric Analysis."

532. NOTE.—As there is always a chance of error in measuring a definite quantity of liquor to be weighed, and also in changing the temperature of the liquor while wiping the bottle after filling it, especially when a perforated stopper is used, and as such errors affect small quantities more seriously than large quantities, it is advisable in all cases to weigh the largest quantity of a liquor which the balance will carry, provided enough liquor is at command. For example.—8 fluid ounces of water (3500 grains) weighed in a balance that turns with $\frac{1}{4}$ -grain, will give a more accurate result than 500 grains weighed in a much more accurate balance; because there may be in both cases an error of one grain in filling the bottle and finding the temperature, and that error falls less heavily on 3500 than on 500 grains.

Knowing the power of the balance that is to be used, it is easy, by means of measuring flasks and measuring pipettes (see those articles under the head of "Volumetric Analysis"), to measure off the greatest quantity of liquor that will suit the balance, and this can be done without giving rise to troublesome calculations. In proof of which I give the following tables, which embrace all the ordinary septem, decem, and gramme measures. By the word *septem* I mean the measure of seven grains of water, and by *decem* the measure of ten grains of water, at 62° F.

Grains of Water.	Septems or Decems.	Multipliers.	Grains of Water.	Septems or Decems.	Multipliers.	Grains of Water.	Septems or Decems.	Multipliers.
7	1 S.	$\frac{1000}{7}$	250	25 D.	4	900	90 D.	$\frac{10}{9}$
10	1 D.	100	300	30 D.	$\frac{10}{3}$	1000	100 D.	0
35	5 S.	$\frac{200}{7}$	350	50 S.	$\frac{20}{7}$	1250	125 D.	$\frac{8}{16}$
50	5 D.	20	400	40 D.	$\frac{10}{4}$	1500	150 D.	$\frac{2}{3}$
70	10 S.	$\frac{100}{7}$	500	50 D.	2	1750	250 S.	$\frac{4}{7}$
100	10 D.	10	600	60 D.	$\frac{10}{6}$	2000	200 D.	$\frac{1}{2}$
125	12 $\frac{1}{2}$ D.	8	700	100 S.	$\frac{10}{7}$	2500	250 D.	$\frac{4}{10}$
140	20 S.	$\frac{50}{7}$	750	75 D.	$\frac{4}{3}$	3000	300 D.	$\frac{1}{3}$
150	15 D.	$\frac{20}{3}$	800	80 D.	$\frac{10}{8}$	3500	500 S.	$\frac{2}{7}$
175	25 S.	$\frac{40}{7}$	875	125 S.	$\frac{8}{7}$	5000	500 D.	$\frac{10}{16}$
200	20 D.	5				7000	1000 S.	$\frac{1}{7}$

Grammes.	Multiplier.	Grammes.	Multiplier.	Grammes.	Multiplier.
5	200	25	40	200	5
10	100	50	20	250	4
20	50	100	10	500	2

The first table gives, in the second column, the most common septem and decem measures; in the first column, their equivalents in grains of water at 62° F.; and in the third column, the number of times which the weight in grains must be taken to represent the specific gravity of the liquors that are tried in comparison with water fixed at 1000.

EXAMPLES.—1. 100 septems contains 700 grains of water. If this is divided by 7 and multiplied by 10, we have 1000 as the standard of specific gravities.

2. If a liquor one and a half times the weight of water is weighed in the same bottle, it is clear that 100 septems will weigh $700 + 350 = 1050$ grains. If this number is divided by 7 and multiplied by 10, we have 1500, which is the specific gravity required.

3. A cheap laboratory balance, such as Nos. 430 or 432, which will carry 8 ounces in each pan and turn with $\frac{1}{20}$ grain, will give good general results with a bottle of the form of Fig. 531, and of the capacity of 250 septems = 4 fluid ounces; since even this quantity of concentrated oil of vitriol will be within the range of the balance, for if the sp. gr. of the acid is 1.846, 250 septems of it will weigh 3230.5 grains. According to the table, the equivalent of water is 1750 grains, and if that is divided by 7, and multiplied by 4, it gives 1000. So also, 3230.5, if divided by 7 and multiplied by 4, gives 1846 as the required specific gravity.

4. As a preliminary trial of acid and alkaline solutions that are to be tested volumetrically, a small quantity—such as 5 septems, decems, or centimeter cubes—may be measured off by a pipette

into a light glass vessel and be weighed, and the weight being multiplied by the factor given in the table, the sp. gr. is readily found.

The SECOND TABLE gives the factors to be used in reckoning the product of weighings of gramme (or centimeter cube) measures, expressed in gramme weights.

HYDROMETERS.

HYDROMETERS WHICH SHOW DIRECT SPECIFIC GRAVITY, WATER BEING TAKEN AT 1·000.

Round Pasteboard Cases with pull-off tops, for single hydrometer spindles, are charged three pence each, unless they are unusually large.

A.—HYDROMETERS IN SETS.

Hydrometers, in the form of Glass Spindles, Fig. 534, for determining the specific gravity of all solutions from sp. gr. ·700 to sp. gr. 2·000, water being considered = 1·000. The delicacy of this instrument increases with the number of spindles contained in the set. The entire scale, from ·700 to 2·000, may be contained on one spindle, or on 2, 3, 4, 5, or 7 spindles.

533. Universal Hydrometer, consisting of one spindle, scale from ·700° to 1·000 by degrees of ·005°, and from 1·000° to 1·900° by degrees of ·010°; namely, ·805°, ·810°, 1010°, 1020°, &c., with a solution tube, Fig. 533, and a pasteboard box, 6s.

A useful instrument for preliminary trials, for students, or for common use when approximate indications are sufficient. It shows the specific gravity of all liquids, from alcohol to oil of vitriol.

HYDROMETERS IN SETS, having spindles of the form of Fig. 534, each set with a Thermometer, Fig. 535, and Trial Jar for solutions, Fig. 536, in a Polished Mahogany Box, Fig. 539.

537. Box containing two Spindles, with Thermometer, and a Trial Jar for the solutions, 22s.

Spindle *a*, scale ·700° to 1·000°, by ·010°.

Spindle *b*, scale 1·000° to 2·000°, by ·010°.

The two spindles separately, 3s. each.

538. Box containing three Spindles, form of Fig. 534, with Thermometer and Trial Jar for solutions, 27s.

Spindle *a*, scale ·700° to 1·000°, by ·002°.

Spindle *b*, scale 1·000° to 1·400°, by ·002°.

Spindle *c*, scale 1·400° to 1·970°, by ·002°.

539. Box containing four Spindles, with Thermometer and Trial Jar for solutions, Fig. 539, 31s. 6d.

Spindle *a*, scale ·700° to 1·000°, by ·001°.

Spindle *b*, scale 1·000° to 1·300°, by ·001°.

Spindle *c*, scale 1·300° to 1·600°, by ·001°.

Spindle *d*, scale 1·600° to 1·950°, by ·001°.

540. Box containing five Spindles, with Thermometer and Trial Jar for solutions, 36s.

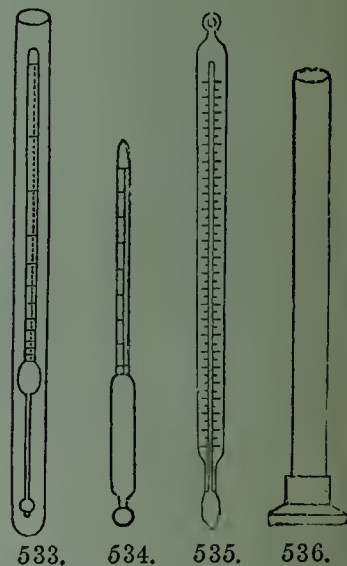
Spindle *a*, scale ·700° to 1·000°, by ·001°.

Spindle *b*, scale 1·000° to 1·200°, by ·001°.

Spindle *c*, scale 1·200° to 1·400°, by ·001°.

Spindle *d*, scale 1·400° to 1·640°, by ·001°.

Spindle *e*, scale 1·640° to 1·900°, by ·001°.

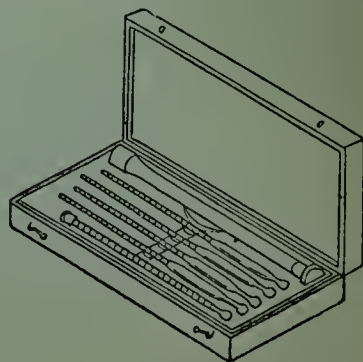


533.

534.

535.

536.



539.

541. Box containing seven spindles, with Thermometer and Trial Jar for solutions, 42s.

Spindle *a*, scale $\cdot 700^{\circ}$ to $\cdot 850^{\circ}$, by $\cdot 001^{\circ}$.

Spindle *b*, scale $\cdot 850^{\circ}$ to $1\cdot 000^{\circ}$, by $\cdot 001^{\circ}$.

Spindle *c*, scale $1\cdot 000^{\circ}$ to $1\cdot 200^{\circ}$, by $\cdot 001^{\circ}$.

Spindle *d*, scale $1\cdot 200^{\circ}$ to $1\cdot 400^{\circ}$, by $\cdot 001^{\circ}$.

Spindle *e*, scale $1\cdot 400^{\circ}$ to $1\cdot 600^{\circ}$, by $\cdot 001^{\circ}$.

Spindle *f*, scale $1\cdot 600^{\circ}$ to $1\cdot 800^{\circ}$, by $\cdot 001^{\circ}$.

Spindle *g*, scale $1\cdot 800^{\circ}$ to $2\cdot 000^{\circ}$, by $\cdot 001^{\circ}$.

542. Set of Hydrometers, 3 Spindles, 5 to 7 inches long, in pasteboard cases, 6s., or each Spindle, 2s.

1. Specific Gravity, $\cdot 75$ to $1\cdot 00$ by $\cdot 01$.

2. " " $1\cdot 00$ to $1\cdot 50$ by $\cdot 01$.

3. " " $1\cdot 50$ to $2\cdot 00$ by $\cdot 01$.

543. Set of Hydrometers, 3 Spindles, in pasteboard cases, 12s. or each Spindle, 4s.

1. Specific Gravity, $\cdot 700$ to $1\cdot 000$ by $\cdot 005$.

2. " " $1\cdot 000$ to $1\cdot 400$ by $\cdot 005$.

3. " " $1\cdot 400$ to $2\cdot 000$ by $\cdot 005$.



544.



545.

544. Set of Hydrometers, 3 glass spindles, each containing a Thermometer, Fig. 544, the Spindles in three pasteboard cases, 15s., or each spindle 5s.

1. Specific Gravity $\cdot 700$ to $1\cdot 000$ by $\cdot 005$.

2. ditto $1\cdot 000$ to $1\cdot 400$ by $\cdot 005$.

3. ditto $1\cdot 400$ to $2\cdot 000$ by $\cdot 005$.

545. Set of Hydrometers for use when only small quantities of liquid are at command, consisting of two narrow spindles without bulb, to be used with a narrow solution tube having a funnel shaped mouth, which prevents the adhesion of the hydrometer to the sides of the tube, Fig. 545, one Spindle from $\cdot 700$ to $1\cdot 000$, the other from $1\cdot 000$ to $2\cdot 000$, per pair, 7s.

546. Nicholson's Hydrometer, consisting of two glass Spindles, with caps at the top, and a set of weights, for taking the specific gravity of any liquids, lighter or heavier than water; with thermometer, in a case, 25s.

B.—HYDROMETERS IN SINGLE SPINDLES.

547. Specific Gravity $\cdot 700$ to $1\cdot 000$ by $\cdot 010$, 3s.

548. " " $\cdot 700$ to $1\cdot 000$ by $\cdot 005$, 3s. 6d.

549. " " $1\cdot 000$ to $2\cdot 000$ by $\cdot 010$, 3s.

550. " " $1\cdot 000$ to $1\cdot 500$ by $\cdot 005$, 3s.

551. " " $1\cdot 000$ to $1\cdot 500$ by $\cdot 005$, open scale, 4s.

Spindles without bulbs, Fig. 545, (without the solution tube).

552. $\cdot 700$ to $1\cdot 000$, 2s. 6d.

553. $1\cdot 000$ to $2\cdot 000$, 2s. 6d.

Delicate Hydrometers, slender Spindles, wide scales, each 4s.

554. Specific gravity, $\cdot 800$ to $\cdot 875$ by $\cdot 001$.

555. " " $\cdot 875$ to $1\cdot 000$ by $\cdot 001$.

556. " " $1\cdot 000$ to $1\cdot 300$ by $\cdot 002$.

557. " " $1\cdot 300$ to $1\cdot 600$ by $\cdot 002$.

558. " " $1\cdot 600$ to $1\cdot 900$ by $\cdot 002$.



559.

Large Hydrometer, stem slender and delicate, for determining the specific gravity of weak solutions, a little exceeding the density of water, such as weak bleaching liquors, milk, urine, &c., form of Fig. 559, the bulb large and stem very narrow, each 6s.

559. Specific gravity, 1·0000 to 1·0250 by ·0005.

560. " " 1·0000 to 1·0600 by ·0005.

561. Hydrometer, with slender stem, scale from 1·0000 to 1·0700 by ·0005, 4s.

Hydrometers with Special Scales.

TWADDELL'S HYDROMETERS, Griffin's improved form, in which the round bulb is replaced by a pear-shaped body, Fig. 562. The advantages of this form are, greater sensibility, greater durability, and the power of taking the density of a smaller quantity of liquid.

As the specific gravities of liquids are commonly denoted in books, in reference to hydrometers which indicate the direct specific gravity of liquids, in comparison with that of water, taken as a standard, and denoted by 1,000, whilst manufacturers in this country are much in the habit of speaking of specific gravities in reference to the scale adopted by the late Mr. W. Twaddell, it may be useful to show the relation of the degrees marked on *Twaddell's Hydrometers*, to those which express the direct specific gravity of a liquid. The necessary calculations are made by means of the following Formulæ :—

Let a = any degree of Twaddell's Hydrometer,
 x = specific gravity in relation to water taken at 1·000.

Formula 1.—To convert Twaddell's degrees into sp. gr. $x = 1. + (a \times \cdot 005)$

Formula 2.—To convert sp. gr. into degrees of Twaddell. $a = \frac{x - 1}{\cdot 005}$

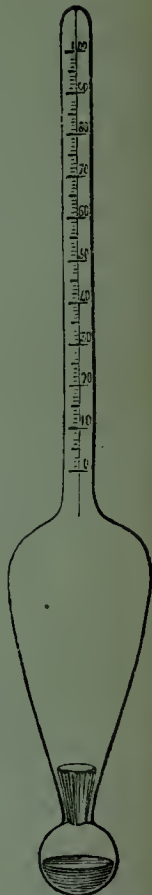
Example 1.—If a liquid marks 5 of Twaddell, what is its sp. gr. ?

By *Formula 1.*—Sp. gr. = $1. + (5 \times \cdot 005) = 1\cdot 025$.

Example 2.—If a liquid has the sp. gr. of 1·850, what degree of Twaddell's scale will that indicate ?

By *Formula 2.*—Twaddell = $\frac{1\cdot 850 - 1}{\cdot 005} = \frac{\cdot 850}{\cdot 005} = 170$.

Hence 5 of Twaddell = specific gravity of 1·025. And 170 of Twaddell = specific gravity of 1·850.



562.

TABLE OF SPECIFIC GRAVITIES INDICATED BY TWADDELL'S SCALE.

Twaddell.	Sp. Gr.	Twaddell.	Sp. Gr.	Twaddell.	Sp. Gr.	Twaddell.	Sp. Gr.
0	1000	50	1250	100	1500	150	1750
10	1050	60	1300	110	1550	160	1800
20	1100	70	1350	120	1600	170	1850
30	1150	80	1400	130	1650	180	1900
40	1200	90	1450	140	1700	190	1950

562. Twaddell's Hydrometer consists of six Spindles, which have the following scales :—

No.	1.	0° to	24°	Specific Gravity	1·000 to 1·120.	Price	1s. 6d.
2.	24	—	48	—	1·120 — 1·240.	—	1s. 6d.
3.	48	—	74	—	1·240 — 1·370.	—	1s. 9d.
4.	74	—	102	—	1·370 — 1·510.	—	1s. 9d.
5.	102	—	138	—	1·510 — 1·690.	—	2s.
6.	138	—	170	—	1·690 — 1·850.	—	2s.

With Pasteboard Cases, 3d. each extra.

563. Twaddell's Hydrometers, the set of six Spindles, in a Mahogany Case, 15s.

563a. The set of six Spindles without cases, 10s.

564. Twaddell's Hydrometers, the original form, spherical, like Figure 559, weighted with lead. The set of six Spindles without paper cases, 7s. 6d.

Single Spindles, as follows:—

Nos. 1 and 2, at 1s. Nos. 3 and 4, at 1s. 3d. Nos. 5 and 6, at 1s. 6d.

With Pasteboard Cases, 3d. each extra.

565. Twaddell's Hydrometers, pear shaped, with ivory scales.

Nos. 1, 2, 3, each 2s. 6d.

Nos. 4, 5, 6, each 3s.

566. BAUMÉ'S HYDROMETERS, for Heavy Liquids.

EXPLANATION OF BAUMÉ'S SCALE FOR HEAVY LIQUIDS.—Manufacturers who employ Baumé's Hydrometer, or have occasion to know the value of the degrees on his scale, may find the following formula useful.

Let B = Baumé's degree, and 100 = water. Then

$$\text{Specific gravity} = \frac{144}{144 - B}$$

That is to say, 144 divided by the difference between 144 and the given degree of Baumé, is the specific gravity in question, stated in reference to water assumed = 100. Thus, suppose Baumé = 66°. Then

$$\text{Specific gravity} = \frac{144}{144 - 66} \text{ or, } \frac{144}{78} = 1.846 = \text{specific gravity.} \text{---DR. CLARK.}$$

SCALE OF BAUMÉ'S HYDROMETER FOR HEAVY LIQUIDS.

B.	Sp. Gr.	B.	Sp. Gr.	B.	Sp. Gr.	B.	Sp. Gr.
0	1.000	20	1.161	40	1.385	60	1.714
5	1.036	25	1.210	45	1.454	65	1.823
10	1.075	30	1.263	50	1.532	70	1.946
15	1.116	35	1.321	55	1.618	76	2.118

SCALE OF BAUMÉ'S HYDROMETER FOR LIGHT LIQUIDS.

10°	1.000	18°	.942	26°	.892	34°	.847
12°	.985	20°	.928	28°	.880	36°	.837
14°	.970	22°	.915	30°	.871	38°	.827
16°	.955	24°	.903	32°	.856	40°	.817

Hydrometers with Baumé's scale bear many names according to their respective applications: Alcoholometers, Saccharometers, Pèse Acides, &c.; but they are all founded on the above two scales, one for liquids heavier than water, and the other for liquids lighter than water.

567. Baumé's Hydrometer, for heavy liquids, scale 0° to 70°, with an additional scale, showing specific gravities from 1.000 to 2.000; 3s.

567 a. The same with a Thermometer, 4s. 6d.

568. Baumé's Hydrometer for light liquids, scale 10° to 40° with an additional scale, showing specific gravities from .700 to 1.000; 2s. 6d.

568 a. The same with Thermometer; 4s.

569. Baumé's Hydrometer for acids, one Spindle, scale 0° to 70°, weighted with lead, 1s. 6d.

569 a. Ditto Ditto weighted with mercury, 2s.

570. Baumé's Hydrometer for light liquors, one spindle from 10° to 40°, weighted with lead. 1s.

571. GAY-LUSSAC'S VOLUMETER, for determining the specific gravity of liquids, compared with water, fixed at 100° of the scale.

No. 1 for Liquids lighter than water, 2s. 6d.

2 for Liquids heavier than water, 2s. 6d.

ALCOHOLOMETERS.

572. NORMAL ALCOHOLOMETER, according to TRALLES, one glass spindle, scale from 0° to 100° , each degree showing 1 per cent. by volume of pure Alcohol of sp. gr. 0.7939, in any mixture of Alcohol and water, at the temperature of 60° F., with thermometer, the Royal Prussian Stamp and Certificate of the standard, tables for reduction, and trial cylinder, in a neat leather case, 20s.
573. Normal Alcoholometer, according to Tralles, one spindle with thermometer as above, in a paper case, 10s. 6d.
574. Tralles's Centesimal Alcoholometer, one glass spindle, scale 0° to 100° , each degree showing 1 per cent. by volume of pure alcohol, of sp. gr. 0.7939, in any mixture of spirit and water at the temperature of 60° F. 2s. 6d.
575. Ditto with thermometer enclosed, 4s.
576. Tralles's Brandy proof, up to 60 per cent., one glass spindle, 1s. 6d.
577. Tralles's Centesimal Alcoholometer, accompanied by Sikes's scale, one glass spindle, with thermometer, 4s.
- Tralles's Alcoholometer is the one now used officially in the United States of America, having been adopted after a careful scientific examination of all known instruments.
578. Gay-Lussac's Centesimal Alcoholometer, one glass spindle, scale 0° to 100° , each degree showing 1 per cent. by volume of pure Alcohol of sp. gr. 0.795, in any mixture of spirit and water, at the temperature of 15° Centigrade, or 59° F., 2s.
578. *a.* Ditto with thermometer enclosed, 3s. 6d.
579. Baumé's Alcoholometer, scale to 40° or 50° graduated at 60° F.
- a.* Loaded with lead shot, 1s.
- b.* Loaded with mercury, 1s. 6d.
- c.* Loaded with mercury, and containing a thermometer, 4s.
- The values of this scale are explained at No. 566.
580. Baumé's Alcoholometer, one glass spindle, from 10° to 40° , weighted with mercury, graduated at 60° F.
- a.* Without a thermometer, 2s. *b.* Including a thermometer, 4s.
581. Sikes's Hydrometer, in glass, one spindle, range from about 60° over proof to about 40° under proof.
- a.* With scale on paper, 2s. *b.* With scale on ivory, 2s. 6d.
582. Sikes's Hydrometer for spirits, glass spindle, with double scale on paper, adapted to all temperatures, on the plan suggested by Stokes.
- a.* With separate thermometer in mahogany box, 12s.
- b.* The spindle alone, 5s.
- c.* The spindle, enclosing a thermometer, 7s. 6d.

This Hydrometer consists of a glass spindle containing two Scales, and accompanied by a Thermometer. The degrees on the primary [black] scale represent percentages of Proof Spirit, according to Sikes's Brass Hydrometer, used by the Board of Inland Revenue for testing the strength of Spirit. The range of the Glass Hydrometer is from 40 below proof to 60 above proof. The secondary [red] scale, contrived by Stokes, provides a method of reducing observations made on Spirit at any temperature to the degree proper for the same at the temperature of 55° . The Instrument is cheap, simple, and accurate: it requires no shifting weights, no sliding scale, nor references to a Book of Tables.

DIRECTIONS FOR USING THIS HYDROMETER.

FIRST EXAMPLE. *When the Spirit is ABOVE Proof.*—Nearly fill a glass cylinder with the spirit to be tried; immerse the body of the hydrometer, and let it gently sink till it finds its resting-place.

then observe the degree marked on the red scale, corresponding with the surface of the liquor under trial, and not with that which capillary attraction draws up round the spindle. Suppose the degree to be $37\frac{1}{4}$. Write this number on a slip of paper. Then dip the thermometer into the spirit to ascertain its temperature. Suppose it to be $2\frac{1}{4}$ below zero, or 0° . [The zero, or 0° , of this thermometer corresponds with 55° Fahrenheit. Each degree of the scale is equal to 4° of Fahrenheit.] Write this $2\frac{1}{4}$ on the slip of paper below the $37\frac{1}{4}$, and subtract the lower number from the upper: the remainder is 35. Look for this number on the red scale, and then, turning round the spindle, find what number on the black scale is on a line with 35 on the red scale. You will find it to be 19 *above proof*. This is the true strength of the spirit at 55° F., as would be indicated by Sikes's Brass Hydrometer.

In all cases when the observed temperature is below 0, *subtract* the number of thermometric degrees from the degrees on the red scale; and, on the contrary, when the observed temperature is above 0, *add* the number of the thermometric degrees to the degrees on the red scale. In both cases, the resulting number is one that stands on the red scale level with a number on the black scale, which expresses the true degree of the spirit above or below proof, according to Sikes, at the temperature of 55° F.

SECOND EXAMPLE. *When the Spirit is Proof Strength.*—Suppose the degree shown by the red scale of the hydrometer to be $46\frac{1}{4}$, and the temperature to be $2\frac{3}{4}$ above 0. Write these numbers as before directed, and add them together. The product is 49. Opposite to this number on the red scale, the black scale shows P, which indicates the spirit under trial to be precisely of *proof strength*, according to Sikes, at 55° F.

THIRD EXAMPLE. *When the Spirit is Under Proof.*—Suppose the degree indicated by the red scale to be $62\frac{1}{4}$, and the thermometer to stand at 0. There is then nothing to add to, or subtract from, the observed degree. You examine what degree on the black scale corresponds with $62\frac{1}{4}$ on the red scale. You find it to be 20 *under proof*, which is the true strength of this spirit, according to Sikes, at 55° F.

33. Sikes's Hydrometer for estimating the value of spirits, according to the scale adopted by the British Board of Inland Revenue, double gilt brass instrument, in mahogany box, with ivory thermometer, a book of tables and instructions and trial glass complete, best make, £3 10s.
4. Sikes's Hydrometer, brass, second quality, £2 5s.

SPIRIT BUBBLES, OR BEADS.

5. Round Japanned Box containing 18 spirit bubbles which show degrees of Sikes's Hydrometer, according to the following scale.
Adjusted at 60° Fahrenheit, 7s. 6d.

No. of Bubble.	per cent.	No. of Bubble.	per cent.	No. of Bubble.	per cent.
16	45 OP	22	15 O	28	25 U
17	40 O	23	10 O	29	20 U
18	35 O	24	5 O	30	25 U
19	30 O	25	PROOF	31	30 U
20	25 O	26	5 UP	32	35 U
21	20 O	27	10 U	33	40 U

O signifies over proof. U signifies under proof.

6. Box with 12 spirit bubbles, 5s.
7. Box with 24 spirit bubbles, 10s.
8. Single spirit bubbles, of any desired number, per dozen, 4s.
9. Single spirit bubbles, of coloured glass, per dozen, 7s. 6d.

SACCHAROMETERS.

The specific gravity of solutions of sugar ranges at 62° F. from 1.000 to 1.321, at which last-named density, the solution contains 67 per cent of sugar.

The specific gravity of expressed cane juice is commonly under 1.120, which can be tested with No. 1 of Twaddell's Hydrometer, (see Nos. 562 and 613), or with Baumé's Hydrometer for heavy liquors having a scale from 0° to 16°.

Saccharometers for use in England are graduated at 62° F.; but for use in the West Indies at 84° F.

590. Hermstadt's Saccharometer, one glass spindle with two scales, namely, sp. gr. from 1.000 to 1.321, and percentage of sugar from 0° to 67°, 5s.
591. Ditto with thermometer enclosed, 9s.
592. Hermstadt's Saccharometer, for beer or wort, one glass spindle, scale from 1.000 to 1.100, 3s.
593. Ditto with thermometer enclosed, 4s. 6d.
594. Saccharometer, one glass spindle, scale showing direct specific gravity from 1.000 to 1.350, 3s.
595. Baumé's Saccharometer, one glass spindle, scale 0° to 50° weighted with mercury, 1s. 9d.
596. Ditto weighted with lead, 1s. 3d.
597. Baumé's Saccharometer, one glass spindle, scale 0° to 25°, weighted with lead, each degree in $\frac{1}{4}$ °, 1s. 9d.
598. Baumé's Saccharometer for weak syrups, scale 0° to 10°, each degree in $\frac{1}{10}$ °, weighted with mercury, 2s. 6d.
599. Baumé's Saccharometer, scale 0° to 70°, each degree divided in $\frac{1}{4}$ °, two spindles, weighted with mercury, the pair, 5s. Separately as follows:—
 - No. 1. scale from 0° to 40°, in $\frac{1}{4}$ °, 2s. 6d.
 2. scale from 40° to 70°, in $\frac{1}{4}$ °, 3s.
600. Kaiser's Saccharometer for beer and wort, showing the percentage of dry extract, one glass spindle, scale from 0° to 22°, each degree in $\frac{1}{4}$ °, 2s. 6d.
601. Ditto with thermometer enclosed, 5s.
602. Steinheil's Saccharometer for beer, showing percentage of malt extract to $\frac{1}{10}$ per cent., 3s.
603. Long's Saccharometer for beer, one glass spindle, 3s.
604. Balling's Saccharometer, showing the percentage of pure sugar, one spindle, scale from 0° to 75°, 2s. 6d.
605. Balling's Saccharometer for syrups:—
 - No. 1. scale from 0 to 3°, divided in $\frac{1}{10}$ °, 1s. 3d.
 2. scale from 0 to 20°, divided in $\frac{1}{2}$ °, 1s. 6d.
 3. scale from 0 to 60°, divided in $\frac{1}{1}$ °, 1s. 9d.
607. Balling's Saccharometer for beer and wort, showing the percentage of dry extract to $\frac{1}{10}$ °, 2s.
608. English Saccharometer, showing the strength of worts from water, up to 50 lbs. per barrel, with paper scale, 1s. 9d.
609. The same with ivory scale, 2s.
610. Bates's Patent Saccharometer, best gilt brass instrument with 5 poises; shows the value of wort and low wines, the excess in the weight of a beer barrel of wort above that of water, the solid extract or the true pounds weight per beer barrel, beer gallon, wine gallon, and imperial gallon, and the proportion of solid extract by weight. With thermometer and book of instructions, in mahogany box, £4 10s.

611. Richardson's Saccharometer, with eight weights, the aggregate of which shows to 75 lbs. per barrel, and the range of divisions on the stem show 1 lb. divided into tenths. In mahogany box with book of instructions, £3 10s.
612. Buss's Saccharometer, electro-gilt brass instrument, divided on two sides of the stem, with one weight, showing to 50 lbs. per barrel. With thermometer and book of instructions, in mahogany box, £2 5s.

HYDROMETERS FOR USE IN THE WEST INDIES.

Adjusted at 84° Fahrenheit.

613. Twaddell's Hydrometers, same scales as No. 562, but adjusted at 84° F.
- | | | | | | | | |
|--------|-----|--|--------|---------|--|--------|---------|
| No. 1. | 2s. | | No. 3. | 2s. | | No. 5. | 2s. 6d. |
| No. 2. | 2s. | | No. 4. | 2s. 6d. | | No. 6. | 2s. 6d. |

614. Baumé's Saccharometer, scale from 0° to 40° or 50° at 84° Fahr., 2s.
615. Ditto, scale 0° to 75°, at 84° Fahr., 2s. 6d.

See explanation of scale at No. 566.

616. Baumé's Alcoholometer, one glass spindle, scale 0° to 40°, graduated at 84° Fahr., weighted with lead, 2s.
617. Spirit Bubbles of the various sorts described at No. 585, but adjusted at 84° Fahr. or any other temperature, at the same prices as those adjusted at 60°

MISCELLANEOUS SPECIFIC GRAVITY INSTRUMENTS.

618. OIL GAUGE, or Hydrometer for estimating the purity of Fat Oils, one glass spindle with thermometer enclosed, Fig. 544. 4s. 6d.

Directions for Use.—Give the instrument time to acquire the temperature of the oil, and then observe the degree of the thermometer, as well as the degree of the hydrometer. If the thermometer is at x degrees *above* zero, an equal number of degrees must be deducted from the hydrometer degree. If the thermometer is at x degrees *below* zero, an equal number of degrees must be added to the hydrometer degree. The range of the hydrometer scale is from 22 to 50, and the following table shows the degree of certain common oils:—

Purified Rape Oil	38—39	Southsea train Oil	33
Common Rape Oil	37—38	Nut Oil	32—33
Olive Oil	37—38	Hempseed Oil	30—31
Dötter Oil	32—33	Linseed Oil	29—30
Poppy Oil	32—33		

Mixtures of oils show a mean density. Oils that have been purified are rendered lighter, and show about 1° more on the instrument.

619. Milk Test, one spindle, with scale 0° to 25°, to test good milk mixed with $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ water. 1s. 6d.
620. Milk Test, one spindle, with scale 0° to 35°; more delicate than the preceding. 3s.
621. Lacto-Densimeter of Quevenne; spindle with two scales,—one to show the density of pure milk, another for skimmed milk; both scales expressing the specific gravity of the milk. 2s. 6d.
622. Cremometer of Chevallier, the scale of which shows percentages in mixtures of water and pure milk. 3s. 6d.

The greatest density of cow's milk is 1.035, produced under favourable circumstances. The usual density of pure good milk is 1.030, water being 1.000. A scale of 35 degrees shows, therefore, the

full range between water and the best milk, and serves to register all the information which a trial of the density can elicit.

Instruments for measuring the percentage of cream in milk are described under the head of "Volumetric Analysis."

623. Griffin's Ammonia Meter, for testing liquid ammonia; one spindle, with 125° , which includes the strongest ammonia that can exist at the temperature of 62° F., and extends to all weak solutions: sp. gr. .875 to 1.000. 4s.

Every degree shows seventeen grains of dry ammonia in a decigallon of liquor. In "Chemical Recreations," page 329, a table is given which shows every particular respecting solutions of ammonia; the strength in atoms, the percentage of ammonia, its weight per decigallon in grains, the comparative money value of different solutions per lb., &c.

624. Schatten's Hydrometer for estimating the percentage of Lime in Bone Black, 2s. 6d.

625. Oechsle's Hydrometer for Wine and Must, with two scales and weight, with instructions, 4s.

626. Safety Hydrometer for Mineral Oil, 1s. 6d.

627. Hydrometer for Tannin, 2s. 6d.

628. Pessier's Natrometer, for estimating the soda contained in salts or soda and potash, 2s. 6d.

629. Nicholson's Hydrometer, for taking the specific gravity of solid bodies, such as minerals, Fig. 629, japanned tinplate, 5s.

- 629a. Ditto, polished brass, 6s.



629.

URINOMETERS.

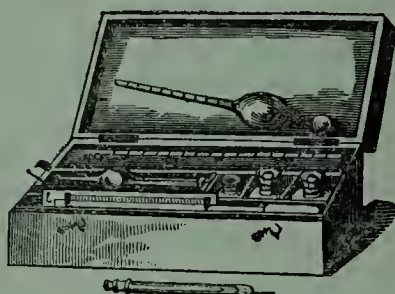
630. Urinometer for determining the specific gravity of urine; small glass spindle, scale $1,000^{\circ}$ to $1,060^{\circ}$, 1s. 9d.

631. Urinometer, spindle with case, trial tube, and round outer leather case for the pocket, 6s.

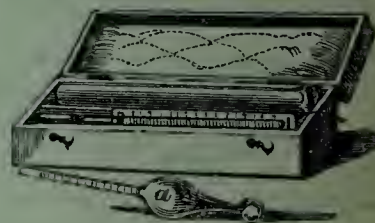
632. Heller's Urinometer, one glass spindle, with trial tube in paper case, 2s.

633. Vogel's Urinometer, two glass spindles, the pair, 3s. 6d.

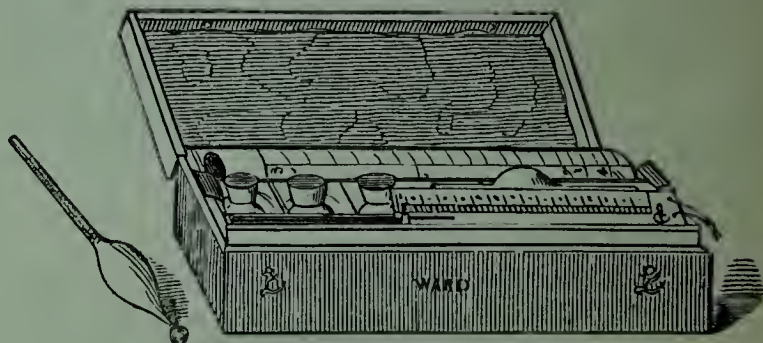
634. Urinometer spindle with case, trial tube and thermometer, in box with hinged top, Fig. 634, 12s. 6d.



635.



634.



636.

635. Urinometer, with graduated solution tube, spirit lamp, thermometer, two capped acid bottles, nest of test tubes, pipette, and two books of test paper, 20s.

636. Urinometer, spindle with graduated solution tube, thermometer, spirit lamp, two capped acid bottles, nest of test tubes, two books of test paper, pipette; the bottles larger than those in No. 635. In a box, Fig. 636, 31s. 6d.

Apparatus and Tests for the CHEMICAL examination of Urine will be described in the section on VOLUMETRIC ANALYSIS.

TRIAL JARS, or SOLUTION TUBES, to contain the liquor the specific gravity of which is to be tried by a HYDROMETER.

637. Glass Jar on foot, cylindrical, with plain mouth, Fig. 637, or with flange or spout, $1\frac{1}{2}$ or $1\frac{3}{4}$ inches wide.

10 inches long, 10d.

12 inches long, 1s.

13 inches long, 1s. 1d.

14 inches long, 1s. 2d.

15 inches long, 1s. 4d.

16 inches long, 1s. 6d.

638. Glass Cylinders, on foot, with widened mouth, Fig. 638.

9 inches high, $1\frac{1}{2}$ inches wide, 2-inch mouth, 1s. 6d.

639. 13 inches high, $1\frac{1}{2}$ inches wide, 2-inch mouth, 1s. 9d.

The use of the widened mouth, or cup, is to prevent the adhesion of the hydrometer to the side of the tube by capillary attraction; an accident which readily happens when the tube is without bulb, as represented in Fig. 643. The cup should be half full of liquor when the hydrometer is at rest in it.

640. Glass Jar, with widened mouth like Fig. 638, and cast-iron foot like Fig. 640, 16 to 18 inches long. 3s.

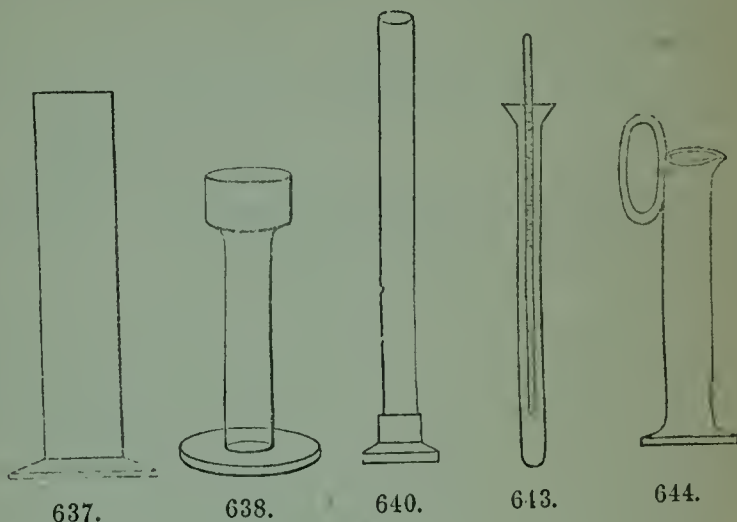
641. Ditto, with brass foot, 17 to 18 inches long. 3s. 6d.

642. Ditto, with wooden foot, 16 to 18 inches long. 2s.

643. Glass Jar, consisting of a tube with a widened mouth, Fig. 643, suitable for narrow hydrometers. 1s.

644. Saltglazed Stoneware Jar, with handle, for dipping into corrosive liquors, the specific gravity of which has to be tried, Fig. 644. 1s. 6d.

645. Tinplate Jars, loaded at bottom, for short hydrometers; 9 inches long, 2 inches wide. 6d.



Pneumatic Apparatus for Chemical Use.

Only such articles are cited in this list as are commonly applicable to Chemical Operations. A complete account of the apparatus proper to demonstrate the principles of the science of Pneumatics will be given in a catalogue specially devoted to that subject.

AIR PUMPS.

AIR PUMPS of the most improved forms, and guaranteed to be in perfect action.

All the screws of Pneumatic Apparatus are made of the *same size and thread*, so that the several pieces are easily fitted to one another.

If an Air Pump is not used for a considerable time, the various parts require the addition of a little oil, which may be easily applied by pouring a tea-spoonful into the centre hole in the brass plate, as shown at *c*, Fig. 646; when a few strokes of the piston up and down will convey the oil to all the internal parts, and the machine will be in good working condition. The ground edges of all Receivers should be smeared with tallow prior to being fixed on the air-pump plate. Stopcocks should be always laid aside *open*; and when a pump is put aside, the blank nut, letter *s*, Fig. 648, should always be screwed into the plate, to prevent the entry of dust.

EXHAUSTING POWER OF THE AIR PUMPS DESCRIBED IN THIS SECTION.—I have added to the description of each pump a reference to its exhausting power. It is proper to state in what manner these powers were ascertained. This was by trial with syphon gauges. The pumps were new, and therefore in good order; the joints screwed tight together; the washers, the inside of the pumps, and the leading tubes were well supplied with oil; the receivers were carefully ground on the edges and greased with tallow; and the mercury in the syphon gauges, which were of the form represented in Fig. 695, and of which several were used at once, had been recently boiled in the tubes. The temperature of the room in which the trials took place was about 55° F., and the barometer stood at 30 inches. The results are quoted in the following table:—

1. The Kind of Pump tried.	2. Capacity of Receiver, 960 cubic inches; its Base, 9 inches diameter.	3. Capacity of Receiver, 280 cubic inches; its Base, 7 inches diameter.	4. Capacity of Receiver, 86 cubic inches; its Base, 4 inches diameter.	5. Capacity of Receiver, 25 cubic inches; its Base, 2 inches diameter.
Under columns 2 to 5 is shown the atmospheric pressure indicated by the syphon gauges at the point of greatest exhaustion.				
646. 2-barrel Pump, 8-inch plate		$\frac{1}{4}$ inch.	$\frac{3}{16}$ inch.	$\frac{1}{8}$ inch.
647. Ditto, 10-inch plate	$\frac{3}{8}$ inch.		$\frac{1}{4}$ inch.	$\frac{1}{8}$ inch.
648. Tate's Pump, 7-inch plate		$\frac{1}{10}$ inch.	$\frac{1}{10}$ inch.	$\frac{1}{20}$ inch.
651. Ditto, large 1, 10-inch plate	$\frac{1}{8}$ inch.		$\frac{1}{10}$ inch.	$\frac{1}{10}$ inch.
652. 3-barrel Pump, 10-inch plate, when the vertical barrels were used	$\frac{3}{8}$ inch.		$\frac{1}{4}$ inch.	
Ditto, when the horizontal pump was used		$\frac{3}{16}$ inch.	$\frac{1}{8}$ inch.	$\frac{1}{20}$ inch.
653. Pump with fly wheel. . .	$\frac{1}{8}$ inch.		$\frac{1}{10}$ inch.	$\frac{1}{10}$ inch.

The RESIDUES of air left in the Receivers according to these Indications are as follow:—

$$\begin{array}{|l|l|l|} \hline \frac{1}{10} \text{ inch} = 1 \text{ in } 600 & \frac{1}{8} \text{ inch} = 1 \text{ in } 240 & \frac{1}{4} \text{ inch} = 1 \text{ in } 120 \\ \frac{1}{10} \text{ inch} = 1 \text{ in } 300 & \frac{3}{16} \text{ inch} = 1 \text{ in } 160 & \frac{3}{8} \text{ inch} = 1 \text{ in } 80 \\ \hline \end{array}$$

For the sake of those who may wish to try the power of their pumps in this manner, I may add to the conditions of trial above cited a caution respecting the syphon gauges. In their ordinary

condition,—that is to say, after having been for some time exposed to the air,—the syphon gauges are of no use for such trials as those recorded above. For such experiments the mercury must be *recently boiled in the gauges*, and then they retain the power of giving accurate results for only a short time. If they are exposed for two or three days to the air, they lose their power. If on the day they are made they are put under a receiver, and repeatedly exhausted and refilled with air, they are thus deprived of their proper power. The air in the gauge gets among the mercury, and puts an end to its accurate indications. When the exhausting power of a pump is tested by a gauge thus deteriorated, the exhaustion appears to be much greater than it actually is, even when the quantity of air in the gauge is so small that it cannot be seen as a bubble in the mercury, either by the naked eye or with a lens; while the existence in the gauge of a very small *visible* bubble of air will enable the pump to reduce the mercury in the closed limb of the gauge lower than that in the open limb: in other words, the exhaustion will appear to take out of the receiver more air than it contained, and thus reduce the atmospheric pressure to less than nothing.

Just as it is possible to make the power of a pump appear to be better than it is by using a fallacious gauge, so it is possible to err the other way, and by neglecting to take the precautions which I have pointed out, make the power appear to be *worse* than it is. A pump cannot, indeed, be always *new*; but it is always possible to see that its pistons and valves are in good order, that the pump is clean and well oiled, that its parts are screwed tight together and fixed firmly to a table, and that the receivers are ground smooth on the edges, and are clean and properly greased. Without taking these precautions, a pump cannot be made to work well.

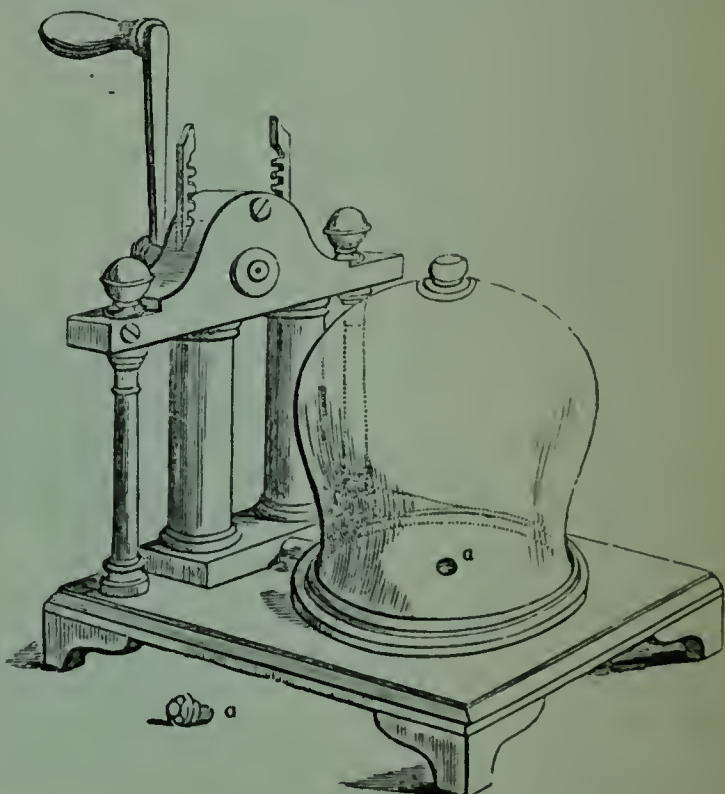
Notwithstanding what is said above, the syphon gauge is highly useful for comparative experiments, and to indicate results approximately.

I have not stated in the trials recorded above the number of strokes that are required to produce each effect: that indication of power is much subject to variations from accidental circumstances, such as the greater or lesser rapidity of the strokes, and the greater or lesser accuracy with which the piston of Tate's pump is driven or pulled home to the end of the barrel at each stroke.

Neither have I answered a question that is frequently asked,—How many minutes will it require with a given pump to freeze water? Generally, I may say, that any pump will freeze water over sulphuric acid, if it will produce pretty readily a vacuum indicated by $\frac{1}{4}$ inch of mercury in the syphon gauge. But one cannot fix the *quantity* of water to be frozen and the *time* to effect the freezing without knowing the power of the pump, the size of the receiver, the strength of the acid, the temperature of all parts of the apparatus, of all the materials to be used, and of the room in which the experiment is to be made. Such details cannot be entered into in this note.

Some readers may, perhaps, consider that the Exhaustions quoted in the above table do not indicate very accurate pumps; for it is very frequently stated in books, that double-barrelled pumps will exhaust to 1 in 1,000, when the mercury in the gauge will be at $\frac{1}{100}$ inch. No doubt, Air Pumps at three times the cost of any in this list could be made a little more accurate than these are; but I fancy that when the above statement is made as regarding ordinary working Air Pumps, due care has not been taken to distinguish the power of the pump from the fallacy of the gauge.

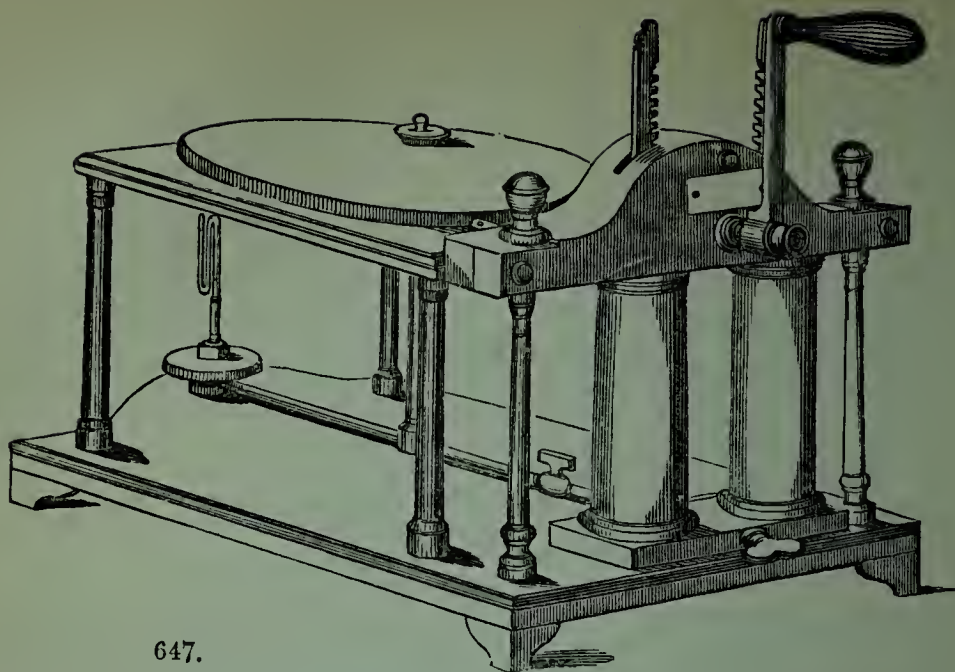
646. AIR PUMP, double barrels, $6\frac{1}{2}$ inches long, $1\frac{1}{2}$ -inch bore, $4\frac{3}{4}$ -inch stroke, with 8-inch plate, on mahogany stand, and stopcock between the plate and the barrels, Fig. 646, £8 8s.



646.

Exhausting Power of this Pump; see page 60.

RECEIVERS of various forms and sizes suitable for the different Air Pumps are described between Nos. 655 and 681. The pumps are without receivers at the quoted prices.

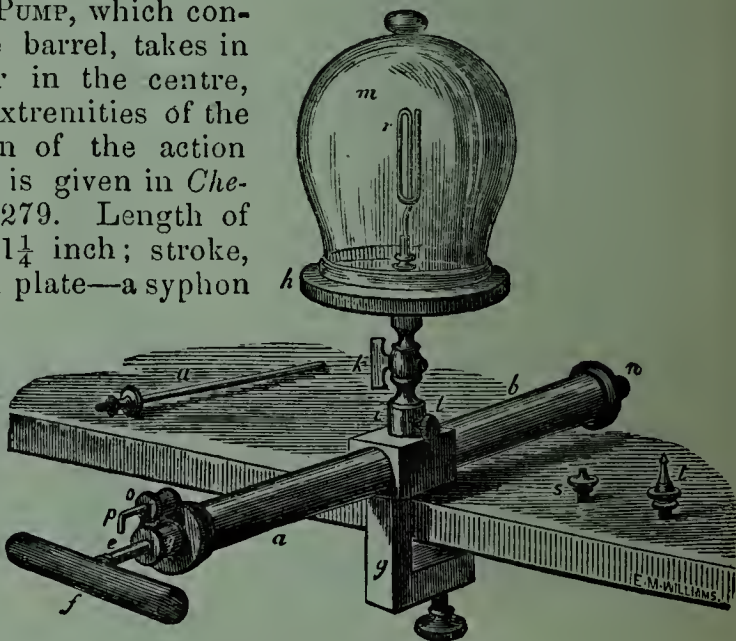


647.

647. AIR PUMP, double barrels, 7 inches long, $1\frac{3}{4}$ -inch bore and $5\frac{1}{2}$ -inch stroke, with 10-inch ground plate on mahogany stand, supported by four pillars, with small gauge plate, mercury gauge, and key, Fig. 647, £12 12s.

Exhausting Power of this Pump ; see page 60.

648. TATE'S DOUBLE-ACTION AIR PUMP, which contains two pistons in one barrel, takes in the air from the receiver in the centre, and expels it at the two extremities of the barrel. A full description of the action and power of this pump is given in *Chemical Recreations*, page 279. Length of barrel, 16 inches; bore, $1\frac{1}{4}$ inch; stroke, $8\frac{1}{2}$ inches. It has a 7-inch plate—a syphon gauge, marked *r*, and a screw, marked *n*, to enable the pump to be used as a condensing pump. It is mounted with a massive brass clamp, by which it can be securely fixed to any solid table, Fig. 648. Price £3 13s. 6d.



648.

Exhausting Power of this Pump ; see page 60.

It will freeze water over sulphuric acid in a receiver of 300 cubic inches, in 150 strokes at about 60° Fahr., and in half that number of strokes at about 40° Fahr.

649. TATE'S AIR PUMP, of the same form and dimensions as No. 648, but mounted on a solid and elegant japanned iron pedestal, represented by *a*, Fig. 649. Price of the pump on pedestal support, with syphon gauge, £3 13s. 6d.

The prices of the extra pieces represented in Fig. 649 will be found at the following numbers:—b, at No. 684 ; c, at No. 686.

The pedestal requires to be screwed to the table where the pump is to be used. The pump is then perfectly solid. On the other hand, the clamp is useful when the pump has to be carried about for use in different localities.

The round box represented at the far end of the pump cylinder in Figs. 649, 650, and 652 is intended to catch the oil, of which more or less is expelled from the pump with the air at every stroke. There is a hole at the upper part of the box to let out the air. From time to time, the oil should be renewed from the box. Though not shown at Fig. 648, this oil-box is now sold with the pump, No. 648.

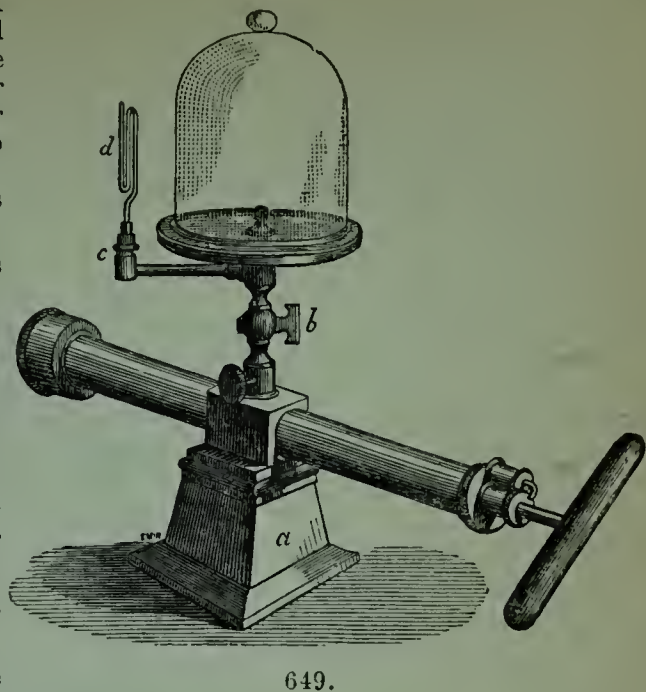
Exhausting Power of this Pump; the same as that of 648.

650. TATE'S AIR PUMP, same form and size as No. 648, but mounted on a solid iron table, *a*, Fig. 650, which has four legs screwed to an iron plate, *b*, which plate can either be fixed permanently to the work table by four screws, or be fastened to it by the large iron clamp, *c*, which permits the removal of the pump. Price of the pump and table, *a*, *b*, with the syphon gauge, *d*, Fig. 649, £3 13s. 6d.

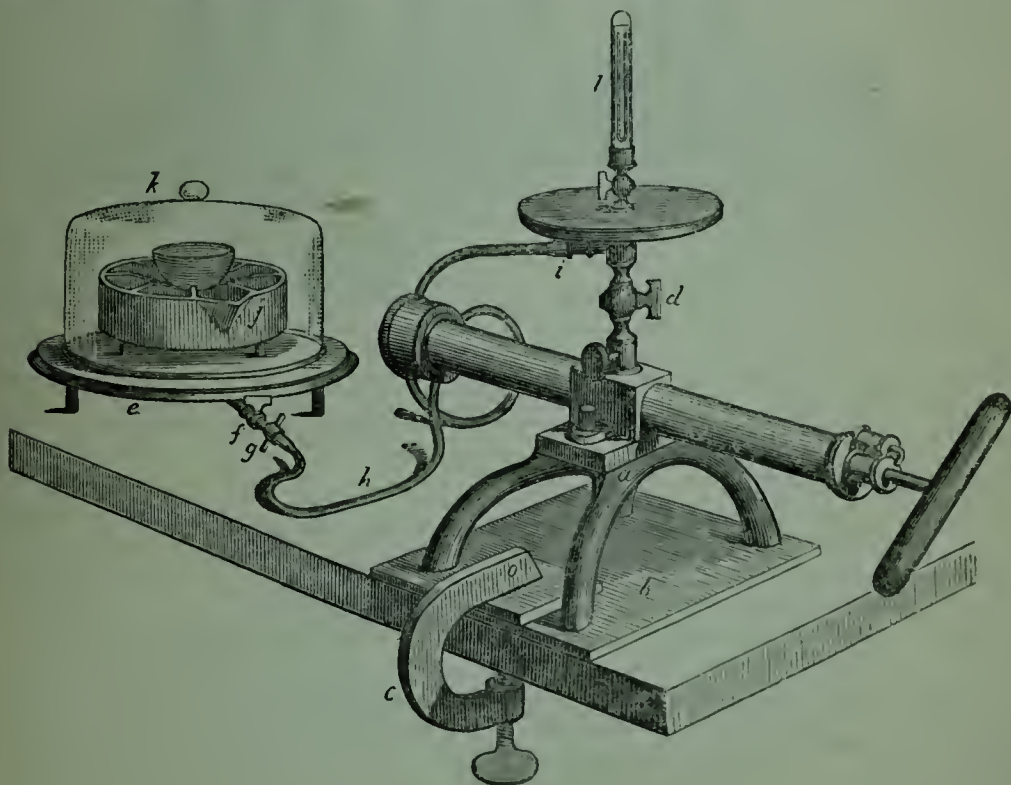
For the prices of other portions of the Apparatus represented by Fig. 650,

see	<i>c</i>	<i>d</i> ,	<i>e, f, g</i> ,	<i>g, h, i</i> ,	<i>j</i> ,	<i>k</i> .	<i>l</i> ,
at No.	725,	684,	687,	690,	692,	655,	695.

Exhausting Power of this Pump; the same as that of Nos. 648 and 649. The three pumps are of the same size and power, and differ only in the style of mounting.



649.

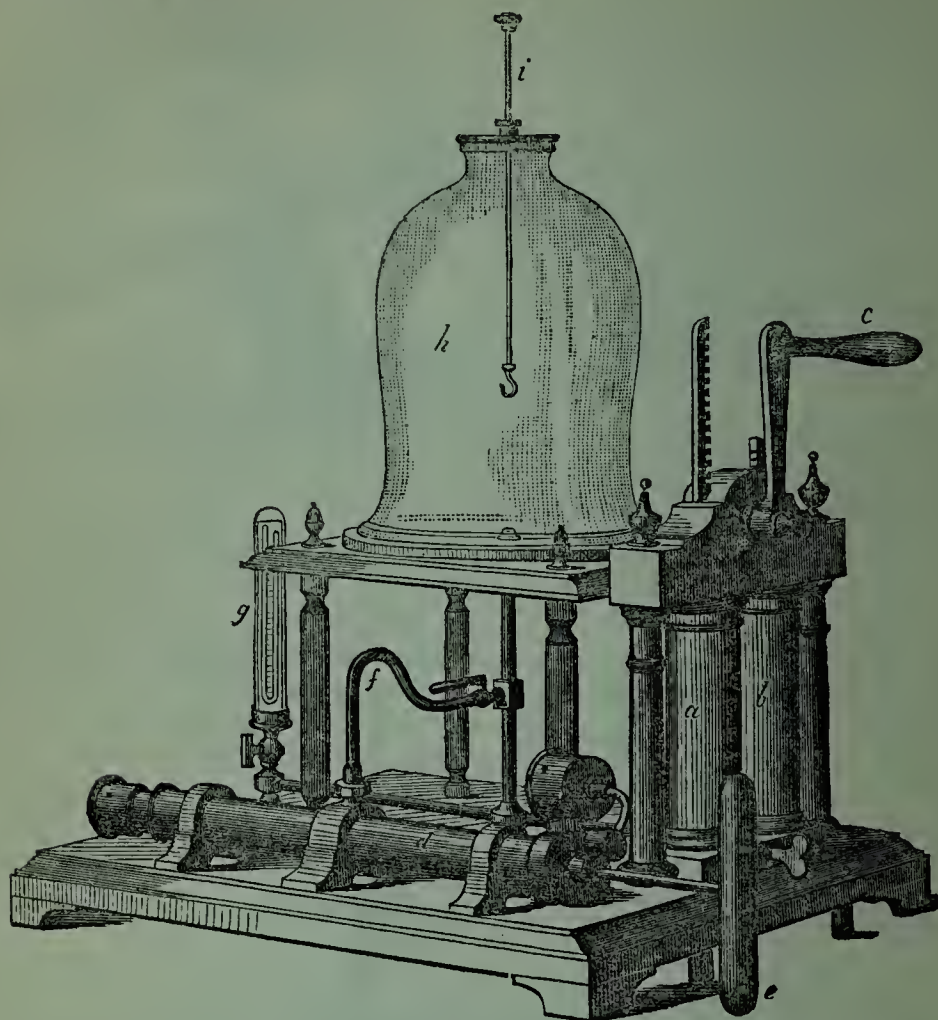


650.

651. TATE'S AIR PUMP, of the same form as the preceding. No. 650, but of ABOVE DOUBLE THE SIZE AND POWER; namely, with a barrel of 17 inches in length. 1½-inch bore, and 9¼-inch stroke. It is mounted on an iron table similar to

a, b, Fig. 650, with a plate of 10 inches diameter, and supplied with the extra joint and arm marked *b, c*, in Fig. 649, and the gauge marked *l* in Fig. 650. This is the largest and most powerful form of Tate's Air Pump which can be conveniently worked without rack-work, lever, or other machinery. It gives great power, is pretty easily worked, and is sold at a moderate price, £8 8s.

Exhausting Power of this Pump; see page 60.



652.

652. AIR PUMP WITH THREE BARRELS, serving either for rapid action at Lectures, or for more complete exhaustion for Researches, Fig. 652. Price, without the jar and rod, *h, i*, £16 16s.

Exhausting Power of this Pump; see page 60.

This Apparatus consists of an Air Pump with two vertical barrels, marked *a, b*, in Fig. 652, which are worked as usual by the handle *c* acting on rack-work. Bore of the vertical barrels, $1\frac{3}{4}$ -inch; length of barrels, 7 inches; stroke, $5\frac{1}{2}$ inches; diameter of the pump plate, 10 inches. With this arrangement, large receivers, having, for example, a capacity of a thousand cubic inches, can be rapidly and easily exhausted till the mercury in the gauge falls to $\frac{3}{8}$ inch, and small receivers can be brought to a vacuum of $\frac{1}{4}$ inch. This is sufficient exhausting power for most of the experiments that are usually exhibited at lectures to illustrate the principles of Pneumatics. But, as more perfect exhaustion is sometimes required, a separate pump on Tate's plan is added to the vertical pump. When the power of the latter ceases, Tate's pump is put into action, and the exhaustion then proceeds, until the mercury in the gauge descends in receivers of a thousand cubic inches to $\frac{3}{16}$ inch, and in small receivers to $\frac{1}{8}$ inch, and even to $\frac{1}{20}$ inch. See the experiments recorded at page 60. This compound Air Pump is therefore adapted either to give quick results when moderate exhaustion is requisite, as at lectures, or more effectual exhaustion when that is required for special experiments or for researches. The extent of the exhaustion is shown by the gauge *g*, on the plan of No. 695, fixed on the lower table of the pump.

The Apparatus is made in the most solid manner, and is mounted on a French polished mahogany frame. The price quoted includes the gauge, but not the rod and receiver marked *h* and *i*.

653. TATE'S AIR PUMP, of large size, arranged for easy and rapid action, worked by a winch and crank, regulated by a fly wheel, £18 18s.

Exhausting Power of this Pump; see page 60.

The barrel is 12 inches long; it has a bore of $2\frac{1}{2}$ inches, and the stroke is 6 inches. The valves are of brass, and work in oil; the barrel is fixed upright. The framework is of iron, and the top is of polished mahogany, bearing a brass pump plate of 10 inches diameter. Upon the mahogany top, there is a screw to receive a syphon gauge, similar to No. 695. There is also a descending gauge tube of 33 inches long below the pump, and by its side a barometer tube dipping into the same mercury cistern, and accompanied by a scale of inches. These tubes are delivered with the pump, but are not filled with mercury, because the filling of the barometer must take place where the pump is established for use, and the mercury must then be boiled in the tube. An oil-box is adapted to each end of the barrel to receive the oil which passes out with the expelled air, and these boxes from time to time must be emptied. When the pump is set up for use, the two ends of the barrel must be unscrewed, and some oil must be put into each of the boxes that contain valves, about 4 fluid ounces in the lower box, and 2 fluid ounces in the upper box. About 2 fluid ounces of oil should also be put into the pump by the hole in the centre of the grand plate, which, on working the handle of the pump, will be distributed throughout the interior.

An Air Pump of this description, which effects with ease in five minutes, in large vessels, a vacuum represented by $\frac{1}{4}$ inch of mercury in the gauge, can be usefully applied in many of the Arts.

REMARKS ON THE COMPARATIVE LABOUR THAT ATTENDS THE WORKING OF THESE AIR PUMPS.—I have stated at page 60, the Comparative *Exhausting Power* of these six Air Pumps; and I will now say a few words on the comparative *Labour* attending their use.

The Air Pumps of the old description, with vertical barrels, such as Nos. 646, 647, and 652, are easy to work *at the beginning* of each exhaustion, and gradually become more difficult as the exhaustion approaches completion. This arises from the increasing pressure of the atmosphere upon the upper faces of the pistons in the barrels when the spaces under the pistons are nearly free from air. With Tate's pump, the contrary effect is produced: at the beginning, the pressure is considerable; but after two or three strokes it gradually becomes easier and easier, the atmosphere being cut off from the pistons by the valves at the ends of the barrel. Pistons of $1\frac{1}{4}$ inch diameter, such as belong to the pump No. 648, are easy to work even at the beginning of a process. But the pump No. 651, which has pistons of $1\frac{3}{4}$ inch diameter, requires for the first two or three pulls a pretty strong hand; besides the atmospheric pressure, there is in this case a much greater amount of friction from the pistons to be overcome: after two or three pulls, it works easily enough. With a view to apply Tate's principle to large pumps, the Apparatus No. 653 has been made. In this case, the force necessary to work the pistons is acquired mechanically, and we have an apparatus that is worked with great facility. It will be observed in the Table given at page 60, that there are three pumps, Nos. 651, 652, 653, having 10-inch plates, which can be used with receivers that hold 1,000 cubic inches of air, and which exhaust these cylinders with the same degree of accuracy, while the respective cost of these pumps is £8 8s., £16 16s. and £18 18s. The higher prices include the cost of the machinery for making the pumps work easily and quickly. The cheapest of these pumps will do the same work as the dearest, if you give it a little more *time* and a little more *labour*. The choice of a pump must be guided by circumstances. If you require rapid exhaustion with easy work, No. 653 is the best pump; and next to it, No. 652: but if economy is an object, the pump No. 651 may be safely taken. Comparing together two pumps of the same price,—namely, Nos. 646 and 651,—the former is easier and quicker in action; the latter is much more effective, and without any other drawback than the two or three stiff pulls at the beginning of an exhaustion. The small Tate's Pumps, Nos. 648, 649, 650, are beyond question greatly superior to all the two-barrelled pumps that are usually sold at twice their price. These small pumps can be worked without difficulty, and, as shown in the Table at page 60, they give excellent results.

BELL-GLASS RECEIVERS FOR AIR PUMPS.

The Air-pump Receivers are all strongly welted and finely ground on the edge, the flat flange that rests upon the air-pump plate being from $\frac{1}{2}$ to $\frac{1}{4}$ inch across. The width of each receiver is measured from outside to outside of the ground flange, to show what size of air-pump plate it is suitable for. The bore, of course, is $\frac{3}{8}$ inch to 1 inch less than the described width. The height is measured inside. When there is a neck, the height is exclusive of the neck.

Receivers of forms suited for particular experiments in Physics will be described in the article 'Pneumatics,' in the Catalogue of Physical Apparatus.

All these Receivers are of hard glass. Those marked B are of fine Bohemian glass and handsomely finished. Those marked G are of hard German glass. The whole are well annealed.

The Receivers Nos. 672 to 677 have flanged mouths, ground flat; the diameter across the flange being $3\frac{1}{2}$ inches.



The Receivers Nos. 678 to 681 have necks from 2 to 2½ inches wide, mounted with BRASS CAPS of the form of No. 714. The Receivers are delivered capped at the prices quoted in the list. The screw in the cap suits the screws of the different stopcocks and connectors, Nos. 697 to 722.

Nos. 655 to 659 are shallow receivers for evaporations over sulphuric acid, the freezing of water, &c. Nos. 660 to 681 are tall receivers.

No.	Width over Flange.	Height Inside.	Figure.	Price.	No.	Width over Flange.	Height Inside.	Figure.	Price.
655	6½ in.	3½ in.	655 G.	2s.	669	9 in.	12 in.	666 G.	8s.
656	8 in.	6 in.	655 G.	3s. 6d.	670	8¼ in.	11½ in.	666 B.	9s.
657	9 in.	5 in.	655 G.	4s.	671	9¾ in.	14 in.	666 B.	15s.
658	9 in.	6½ in.	655 B.	7s.	672	7 in.	6 in.	672 B.	4s. 6d.
659	11½ in.	7 in.	655 B.	12s.	673	7½ in.	12 in.	672 B.	9s.
660	2½ in.	6½ in.	660 B.	1s.	674	10 in.	14 in.	672 B.	14s.
661	5½ in.	7½ in.	660 B.	3s.	675	7½ in.	10 in.	675 B.	7s. 6d.
662	4½ in.	7½ in.	660 B.	2s. 6d.	676	8 in.	11 in.	675 B.	10s. 6d.
663	7 in.	11 in.	660 B.	5s.	677	8½ in.	13 in.	675 B.	12s. 6d.
664	8 in.	12 in.	660 B.	9s.	678	5¾ in.	5½ in.	678 B.	5s.
665	11 in.	14 in.	660 B.	14s.	679	7 in.	8 in.	678 B.	7s.
666	4 in.	7 in.	666 G.	3s.	680	8¼ in.	10 in.	678 B.	11s.
667	7 in.	8 in.	666 G.	4s.	681	10½ in.	12 in.	678 B.	16s.
668	8½ in.	10½ in.	666 G.	6s.					

EXTRA FITTINGS FOR TATE'S PUMP.

684. EXTRA SCREW between the pump plate and the stopcock, represented at the upper part of *b* in Fig. 649, and *d* in Fig. 650, with a blank nut to close it when not required for use, 3s. 6d.

This is not a separate piece of metal, but a prolongation of the stopcock marked *k* in Fig. 648. It is useful for the purposes represented in Figs. 649 and 650.

685. Extra Joint with Screw. Those who already possess Tate's Pump as figured at No. 648, can have an extra joint with this screw supplied at the cost of 5s.

686. ARM TO CARRY A SYPHON GAUGE, applicable to the extra screw No. 684, represented by *c*, Fig. 649, 3s.

The syphon gauge when used merely to test the power of a pump can be screwed into the plate, as shown at *r*, Fig. 648. In that case, a hole is drilled in its brass base to permit the passage of the air. But when it is desired, during the progress of an experiment, to know the extent of exhaustion within the receiver, the gauge can be mounted as represented by Fig. 649. The gauge *d* must then be without the extra hole in its brass base. Instead of this form of gauge, that represented by Fig. 695 can be used in this manner.

687. **EXTRA PUMP PLATE**, for use in drying chemicals in vacuo, or in freezing water, over sulphuric acid, consisting of a cast-iron table mounted on three legs, with plate-glass surface, an air-tube and stopcock, the thread of which fits a union joint, as represented by *e, f, g*, Fig. 650, three sizes.
687. 8-inch Plate, with stopcock, 14s.
688. 10-inch Plate, with stopcock, 18s.
689. 12-inch Plate, with stopcock, 25s.
690. **CONNECTING TUBE**, flexible caoutchouc, wired and glazed, 3 feet long, *h*, Fig. 650; with a screw *i*, to fit the extra joint *d*, and a union joint *g*, to fit the stopcock *f*, of the extra plate, 5s.

One connecting tube serves for any number of separate plates, Nos. 687 to 689, each of the plates having a stopcock to keep the vacuum.

During the exhaustion of a receiver placed over a separate pump plate, a gauge is fixed in the centre of the fixed pump plate as represented by Fig. 650, to mark the progress of the exhaustion.

691. The Connecting Tube, with the stopcock *f, g, h, i*, Fig. 650, complete, 8s.
- Flat Glass Receivers for the extra pump plates, of strong German and Bohemian glass, welded and ground on the edges, see Nos. 655 to 659.
692. Pans for containing Sulphuric Acid, represented at Fig. 650, are described in the section on "Desiccating Apparatus." No. 1285.

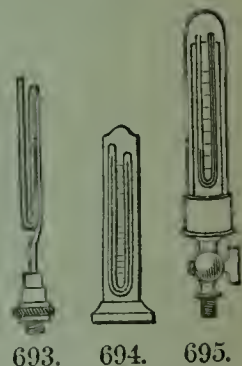
SYPHON GAUGES, for showing the extent of exhaustion effected by air-pumps within their receivers. These are of three kinds:—

693. Common three-limbed Syphon Gauge, mounted on a brass foot, with male screw, Fig. 693, 3s. 6d.

This gauge may be had either with or without an air-hole drilled in the brass foot: see Note to No. 686. It is used as shown by *r*, Fig. 648, and *d*, Fig. 649.

694. Syphon Gauge, with scale, form of Fig. 694, mounted on a flat stand, and requiring to be placed under a receiver for trial, 5s.

695. Syphon Gauge, with glass scale, form of Fig. 695, the gauge enclosed in a glass tube. Price, with stopcock, 8s.
696. Ditto, without stopcock, 5s.



693. 694. 695.

Of these three syphon gauges, the one that is least trustworthy is the first, No. 693, in consequence of the difficulty of filling it with mercury quite free from air. This variety also is not graduated. The other two are graduated to show twentieths of an inch. No. 695 is represented in use by *l*, Fig. 650, and *g*, Fig. 652.

Purchasers of the Pumps, Nos. 648 to 650, with which the gauge No. 693 is delivered, may have No. 695 instead, on payment of the difference in price.

The precautions to be taken to secure accurate results in the use of syphon gauges have been detailed at page 61.

STOPCOCKS AND CONNECTORS.

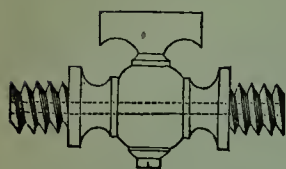
The following Stopcocks and Connectors are all London-made, of the best quality, and of **POLISHED BRASS**.

Stopcocks and Connectors of **POLISHED IRON** cost *one-half* more than those of polished brass.

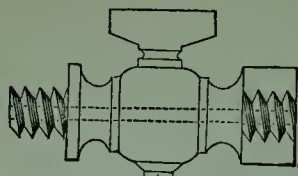
STOPCOCKS:—

697. Stopcock, with two male screws, Fig. 697, 3s.
698. Stopcock, with one male and one female screw, Fig. 698, 3s.

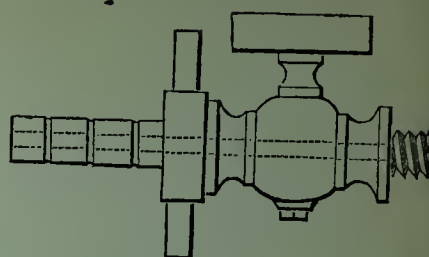
699. Stopcock, with a male screw at one end, and at the other end a union joint and a long brass tube for attaching a flexible tube, Fig. 699, 5s.



697.

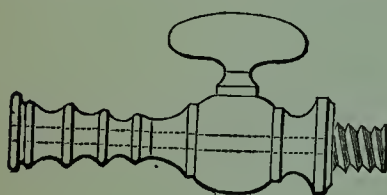


698.

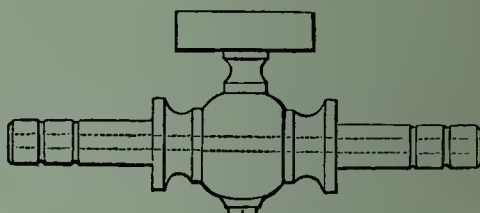


699.

700. Stopcock, with a female screw at one end, and at the other end a union joint and a long brass tube for attaching a flexible tube, similar to Fig. 699, but having a female screw instead of a male screw, 5s.



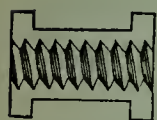
701.



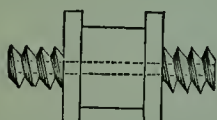
703.

701. Stopcock, with a tube at one end for connecting a caoutchouc tube, and at the other a male screw, Fig. 701, 3s.
 702. A similar Stopcock and Tube, but having a female screw at one end, 3s.
 703. Stopcock, having at each end a tube for connecting a caoutchouc tube, Fig. 703, 3s.

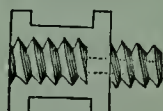
CONNECTORS :—



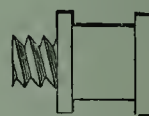
704.



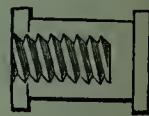
705.



706.



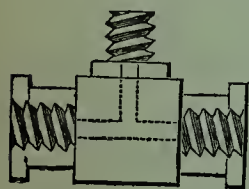
707.



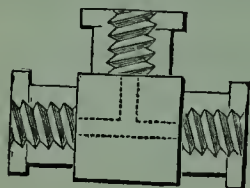
708.

704. Connector, with 2 female screws, Fig. 704, 1s.
 705. Connector, with 2 male screws, Fig. 705, 1s.
 706. Connector, with 1 male and 1 female screw, Fig. 706, 1s.
 707. Blank Nut, with 1 male screw, Fig. 707, 1s.
 708. Blank Nut, with 1 female screw, Fig. 708, 1s.

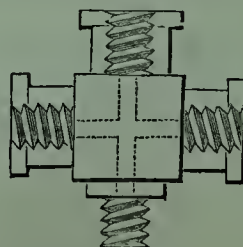
These blank nuts are used to stop openings that are not required, see No. 684.



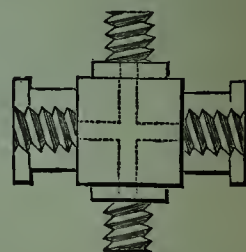
709.



710.



711.



712.

THREE-WAY AND FOUR-WAY CONNECTORS; four patterns, *each*, 2s. 6d.

709. Connector, 2 female screws, 1 male screw, Fig. 709.

710. Connector, 3 female screws, Fig. 710.

711. Connector, 3 female screws, and 1 male screw, Fig. 711.

712. Connector, 2 female screws, and 2 male screws, Fig. 712.

713. BRASS CAPS for Bell Jar Receivers, and for Globes for gases, with female screw; diameters to suit glass necks of $\frac{3}{4}$, 1, $1\frac{1}{4}$ inch, Fig. 713, *each* 1s.

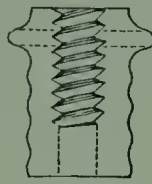
714. Similar Brass Caps, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ inches in diameter, to suit such receivers as Nos. 678 to 681, *each* 2s.

The prices of Cylindrical Receivers and of Globes mounted with brass caps will be given under the head of "Gas Receivers." Some are already stated at Nos. 678 to 681.



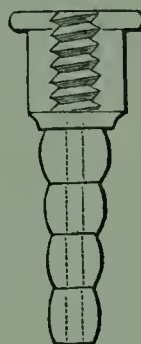
713.

16. Bladder Piece, or Socket to tie in the neck of a bladder or a gas bag, with female screw for receiving a stopcock, Fig. 716, 9d.



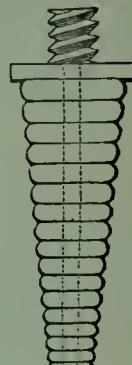
716.

17. Connector for attaching a flexible caoutchouc tube to brass fittings, with female screw, Fig. 717, 9d.



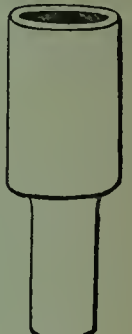
717.

18. Ditto, with male screw, Fig. 718, 9d.



718.

19. Connector to join a $\frac{1}{4}$ -inch to a $\frac{1}{2}$ -inch caoutchouc tube, without screws, Fig. 719, 6d.

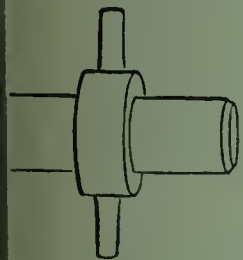


719.

20. Union Joint for connecting two flexible tubes together, Fig. 720, 1s. 6d.

21. Blocks to be screwed to a table, with female screws to receive the ends of syringes, cross pieces, or other articles that need to be fixed in an upright position, two kinds, Fig. 721, flat, 1s.

22. Ditto, raised, 1s.



720.



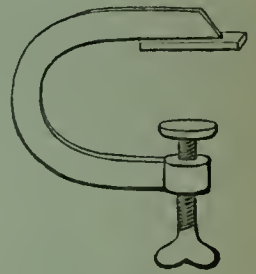
721.



722.



723.



725.

23. Brass Clamp, for fastening an air-pump to a table, &c., $2\frac{1}{2}$ inch, Fig. 723, 3s. 6d.

24. Iron Clamp, Fig. 723, $3\frac{1}{4}$ inch, 1s. 6d.

25. Iron Clamp, $4\frac{1}{4}$ inch, represented by Fig. 725 and by c., Fig. 650, 3s. 6d.

26. Brass Key, for screwing up the joints of air-pump apparatus, connectors to stopcocks, &c.



726.

Single, 1s. 6d.; double, Fig. 726, 2s.

AIR SYRINGES, POLISHED BRASS.

EXHAUSTING SYRINGES, Fig. 727 :—

727. Barrel 5 inches long, $\frac{3}{4}$ -inch outside diameter, 7s. 6d.
 728. Barrel 8 inches long, $1\frac{1}{3}$ -inch diameter, 10s. 6d.
 729. Barrel 9 inches long, $1\frac{3}{4}$ -inch diameter, mounted on a clamp, 30s.
 730. Barrel 12 inches long, 2 inches diameter, mounted on a flange to screw to a table, 42s.
 731. Barrel 12 inches long, $2\frac{1}{4}$ inches diameter, mounted on a flange, 50s.

CONDENSING SYRINGES, Fig. 727 :—

732. Barrel 5 inches long, $\frac{3}{4}$ inch diam., 7s. 6d.
 733. Barrel 8 inches long, $1\frac{3}{8}$ inch diam., 7s. 6d.

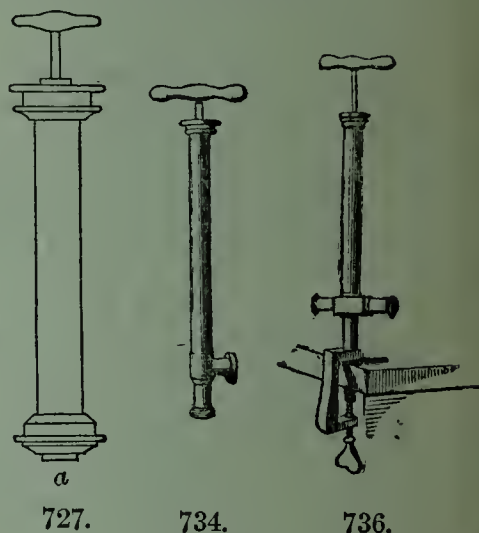
EXHAUSTING AND CONDENSING SYRINGES, form of Fig. 734.

734. Barrel 6 inches long, $\frac{7}{8}$ inch diam., 10s. 6d.
 735. Barrel 8 inches long, $1\frac{1}{3}$ inch diam., 16s.

EXHAUSTING AND CONDENSING SYRINGE, with a Cross-piece and CLAMP to fasten it to a table, Fig. 736.

736. Barrel 6 inches long, $\frac{7}{8}$ inch diameter, 18s.
 737. Barrel 8 inches long, $1\frac{1}{3}$ inch diameter, 27s.

All these Syringes end with female screws.



TALLOW-HOLDER, which consists of a mahogany tube containing a piston moved by a screw, Fig. 741.

741. Small Tallow-Holder for general use, bore $\frac{5}{8}$ -inch, 1s.
 742. Large size, for use with the air-pump, bore $\frac{7}{8}$ -inch, 1s. 6d.

Tallow, or a mixture of tallow and wax, is convenient for greasing the edge of a glass vessel previously to decanting a liquid, in order to prevent the running of the liquid over the edge of the vessel so as to descend outside. Tallow is also required to grease the edge of air-pump receivers, to make them fit the ground plate air-tight. To fill the tallow-holder, the piston is screwed back to the top of the tube, and melted tallow is poured in till the tube is full. After cooling, the tallow is projected as required by turning the screw.



741.

Apparatus for the Production and Application of Heat.

The selection of Apparatus for the Production and Application of Heat in chemical operations, depends, in a great degree, upon the description of FUEL which can be most conveniently and economically procured in any given locality. The necessary apparatus for the production of heat may, for this reason, be arranged under three heads :—

1. Apparatus required when the fuel to be used is charcoal, coke, or coal. This comprehends Iron Furnaces, Clay Furnaces, Chauffers.
2. When the fuel is spirits or oils :—Spirit Lamps and Oil Lamps.
3. When the fuel is coal gas :—Gas Burners, Gas Furnaces.

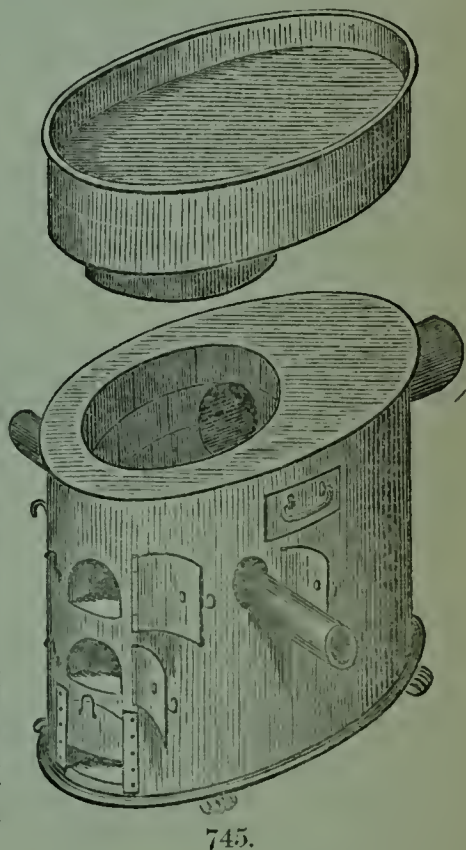
Under the head of "Application of Heat" it will be convenient to refer to Furnace and Lamp Fittings of all kinds, to Crucibles, Tubes, Baths, and other articles adapted for the special experiments that require to be made at high temperatures.

IRON FURNACES.

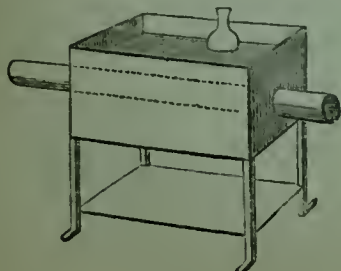
PORTABLE FURNACES, made of strong PLATE IRON, riveted, lined with a Refractory Fire-clay Mixture, or Fire-bricks :—

745. BLACK'S PORTABLE UNIVERSAL FURNACE, for burning coal or coke, oval form, strong iron plate, lined with fire-brick, complete, on feet; fire-room, 9 inches wide and 17 inches deep; height outside, 24 inches; oval top, 21 by 16 inches; with solid cover for the fire-room, and an oval sand-bath to fit the top; the chimney is at the back; one of the front openings is suitable for a muffle of 9 inches long, $4\frac{1}{2}$ inches wide, and 3 inches deep. There are side openings for a tube, as shown in the figure. £6 6s.

746. *Additional Sand-bath Accommodation.*—When additional sand-bath accommodation is required, or when the furnace is to be used to warm the laboratory, an extra table sand-bath, of the form of Fig. 746, may be placed between the Black's furnace and the chimney of the room, a flue passing from the furnace through the sand-bath. This contrivance may be used also with other kinds of furnace. It can be very conveniently adapted to the square Cupelling furnace described in the section on "Assaying," the dome of the furnace being removed, and the body placed below the end of the sand-bath. The free space under the sand-bath may, if required, be closed in, to form a hot chamber, a door being made in front. The price of such an extra sand-bath depends upon its size; it may be from 30s. upwards.



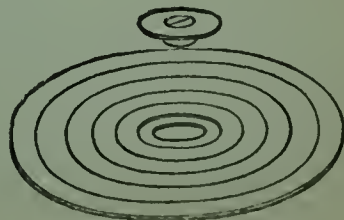
745.



746.

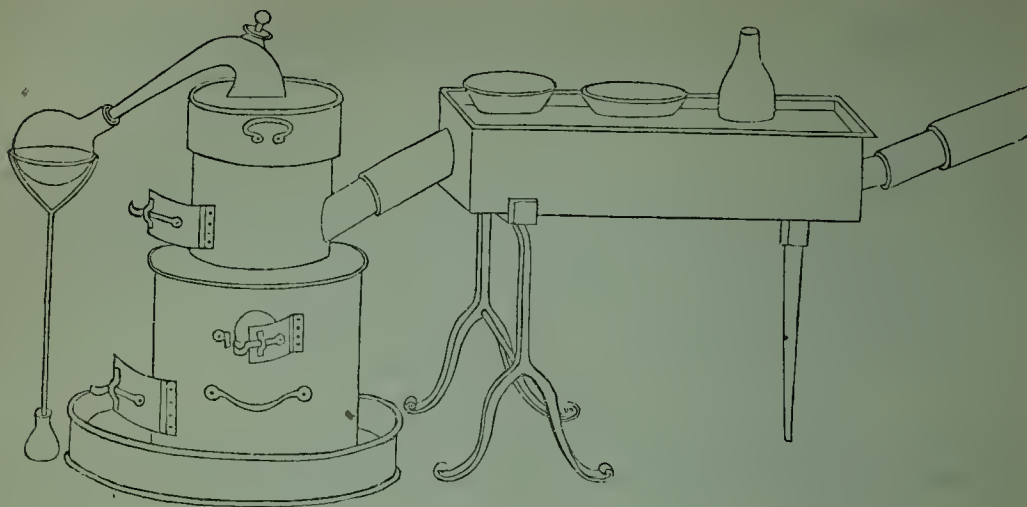


748.



749.

747. SIR HUMPHREY DAVY'S PORTABLE FURNACE, WITH EXTRA SAND-BATH, is represented by Fig. 747. It can obviously be made of any dimensions that may be required.



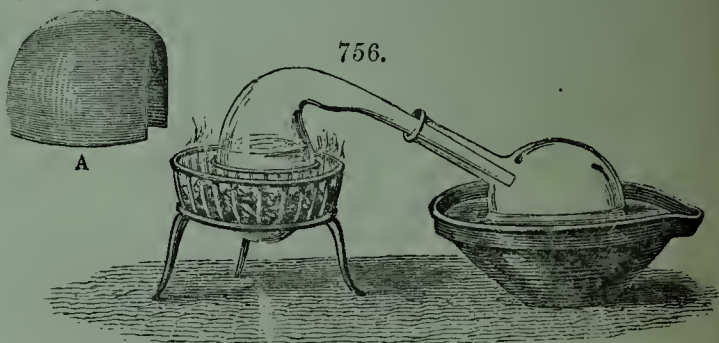
747

748. Deep Cast-iron Sand-bath, to dip into the upper opening of Black's Furnace, and adapt it for distillation with retorts. Size—7 inches deep, 8 inches wide inside, 12 inches over all, Fig. 748. 7s. 6d.
749. Set of 5 Cast-Iron Rings, to adapt Basins of different sizes to the upper opening of Black's furnace. Sizes,— $3\frac{1}{2}$, 5, $6\frac{1}{2}$, 8, $9\frac{1}{2}$, and $11\frac{1}{2}$ inches diameter. Fig. 749, *per set*, 3s. 6d.
750. Muffles for the above furnace, 9 by $4\frac{1}{2}$, by 3 inches, 3s.
751. Two-Gallon Still, tinplate, with moveable top and iron jacket, to adapt it to this furnace, 27s.
752. Condenser for this Still, Mitscherlich's form, which can be opened for cleaning, 16s.
753. Wooden Stool, to adapt the Condenser to the Still, 2s. 6d.

Nos. 751 to 753 will be described more particularly in the section on "Distillation," No. 1891.

754. BLACK'S FURNACE, *smaller size*, circular; the fire-room 8 inches wide, 13 inches deep; the furnace cylindrical; external diameter, $12\frac{1}{2}$ inches; height, 21 inches; with solid cover, side-openings for a tube, and a double-bottomed sand-bath, $12\frac{1}{2}$ inches diameter. £4 10s.

755. Mohr's Universal Furnace (see "Lehrbuch der Pharmaceutischen Technik," page 178), on three legs with a flue; fire-room, 12 inches in diameter, 13 inches deep; external height of furnace, 29 inches, width 17 inches; with sand-bath, 17 inches diameter. £5.



756. Chauffer of Iron Trellis, for applying heat to the sides (and not the bottom) of a retort, for the safe distillation of oil of vitriol, accompanied by an iron dome; size for a three-pint retort, Fig. 756, 12s. 6d.

757. Chauffers, for evaporating and boiling, cast-iron; with iron grate, ash-pit, and base, Fig. 757.

- | | | | | |
|----|--------------------|-----------|-----------------------------|---------|
| a. | 8 inches diameter, | fire-room | $2\frac{1}{2}$ inches deep, | 4s. |
| b. | 10 | " | 3 | 5s. |
| c. | 11 | " | $3\frac{1}{2}$ | 8s. 6d. |



757.

758. Trivets to support vessels over these Chauffers without spoiling the draught, Fig. 758.

8-inch, 6d.

10-inch, 7d.

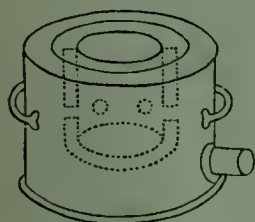
11-inch, 8d.



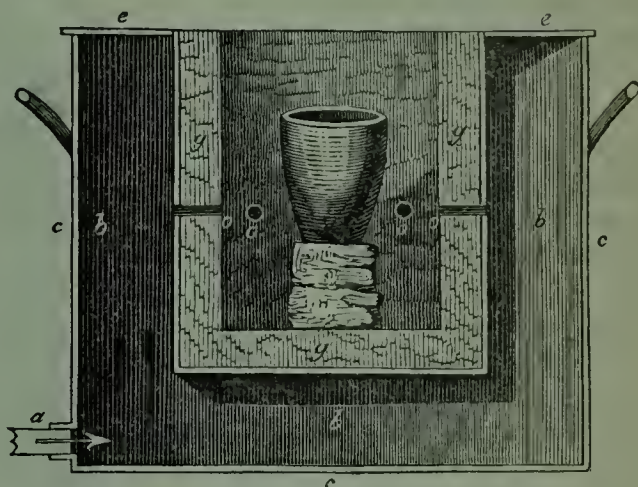
758.

Other varieties of Triangles and Trivets are described at Nos. 299 to 308.

761. FIRE-CLAY, prepared for lining Furnaces, supplied in powder, which requires only to be mixed with water and kneaded into a soft mass to be ready for repairing defects in the lining of Furnaces. *Per cwt.*, 6s.



762a.



762b.

762. SEFSTROEM'S BLAST FURNACE, for fusions at a white heat, consisting of a double furnace, of which Fig. 762 *a* shows the outside, and Fig. 762 *b* a section. Made of stout sheet-iron, lined with fireclay. To be used with coke, or charcoal and coke, cut into pieces of about a cubic inch in size. The blast of air to be supplied by a powerful blowing-machine. Four sizes, as follow :—

Dimensions of Fire Room.			Outside Dimensions.		Price.
Depth.	Width.	Height.	Width.		
762. $6\frac{1}{2}$ inches.	5 inches.	9 inches.	12 inches.		25s.
763. $7\frac{3}{4}$ inches.	$6\frac{3}{4}$ inches.	12 inches.	16 inches.		35s.
764. $10\frac{1}{4}$ inches.	$7\frac{1}{2}$ inches.	15 inches.	18 inches.		45s.
765. 12 inches.	$9\frac{1}{2}$ inches.	18 inches.	24 inches.		58s.

766. MODIFICATION OF SEFSTROEM'S BLAST FURNACE, not so powerful as the foregoing, but more portable, and sufficient for many purposes in pharmacy and in the assaying of metallic ores. Made of fireclay, with an iron casting and iron grate. In this furnace the blast of air passes up through the grate, as in Deville's Forge. Two sizes:—



766.

Outside Measurement.			Size of Fire Room.		
Height.	Width.		Height.	Width.	
766. 12 inches high.	9 inches wide.		8 inches high.	6 inches wide.	16s.
767. 14 inches high.	12 inches wide.		10 inches high.	8 inches wide.	21s.

768. MOHR'S FURNACE on Tripod, with Chimney below to regulate the draught; fire room, 10 inches wide, 11 inches deep; height outside, 34 inches; diameter, 13 inches (see Mohr's Pharmaceutischen Technik, page 181); for use with charcoal and coke, with a set of ring-tops. £3.

769. Smaller size of Furnace, on the same plan as the preceding article; the fire room 5 inches wide, 8 inches deep; height outside, 27 inches; diameter, $7\frac{1}{2}$ inches with a set of three ring-tops. 37s.

CUPELLING FURNACES; see article on "Assaying."

770. DEVILLE'S CHEMICAL FORGE, consisting of a powerful circular blowing-machine, a forge, a blast furnace, and a glass-blowing table combined, £10 10s.

Described in "Chemical Recreations," page 585. To be used with charcoal and coke.

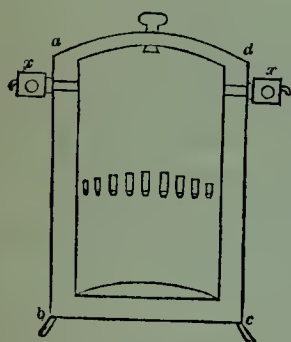
771. DEVILLE'S CHEMICAL FORGE AND BLAST FURNACE, larger and more powerful than the preceding, with double-action bellows giving a continuous and uniform blast, without the glass blowing table, £13 13s.

The blowing-machine of this forge is sufficiently powerful for any of the Blast Gas Furnaces described in a following section; namely, with No. 4 furnace, it will fuse 25 lb. of cast-iron. The price of the Blowing-machine without the forge is £9.

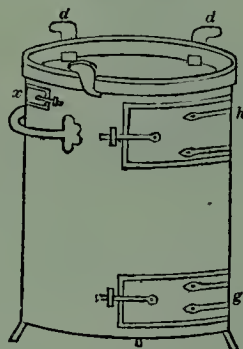


772. LUHME'S PORTABLE FURNACES.

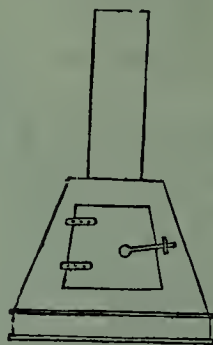
These furnaces are made of very strong iron plates, lined with fireclay; suitable for use with charcoal, but not with coal. Fig. 772 *b* shows the body of the furnace in perspective. Fig. 772 *a* is a section of it. *xx* are doors for closing the openings to admit of a tube. *dd* are projections for holding pans, &c., without stopping the draught. There are three projections inside for smaller vessels. The fittings represented in the other Figures are all adapted to the top of the furnace, and are provided with openings to permit the escape of carbonic acid gas, and so keep up the necessary draught of air. Fig. 772 *c* represents a dome for use in crucible operations. Fig. 772 *f* represents



772a.



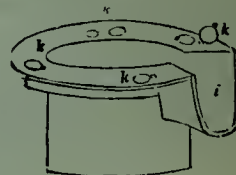
772b.



772c.



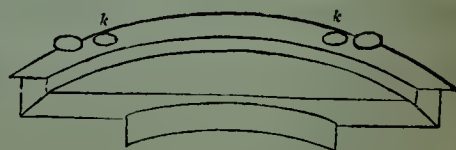
772e.



772f.

a deep sand-bath suitable for distillations with retorts, and Fig. 772 *e* is a jacket for adjusting the deep sand-bath to the furnace. Fig. 772 *d* is a flat sand-bath for operating with flasks, evaporating basins, &c. The temperature is regulated by means of the valves *kk*, and ash-pit door *g*.

Several sizes of this furnace are made, and each size is supplied either with short feet, as represented by the Figures, or on legs of 17 inches in height.



772d.

The following are the usual sizes of Luhme's Furnaces :—

Furnaces with Short Feet.	No. 1.	2.	3.	4.	5.
Diameter of Fire-room.	5½	6	7	9	11½ inch.
Depth of Fire-room.	6	7½	8	9½	13 inch.
Height outside.	11	12	13	15	20 inch.
Diameter outside.	6½	7½	8½	11	14 inch.
Furnaces with Long Legs.	No. 1.	2.	3.	4.	
Diameter of Fire-room.	7	8	9	12 inch.	
Depth of Fire-room.	8½	9½	9½	13 inch.	
Height outside.	30	30	30	30 inch.	
Diameter outside.	8½	10	11	14 inch.	

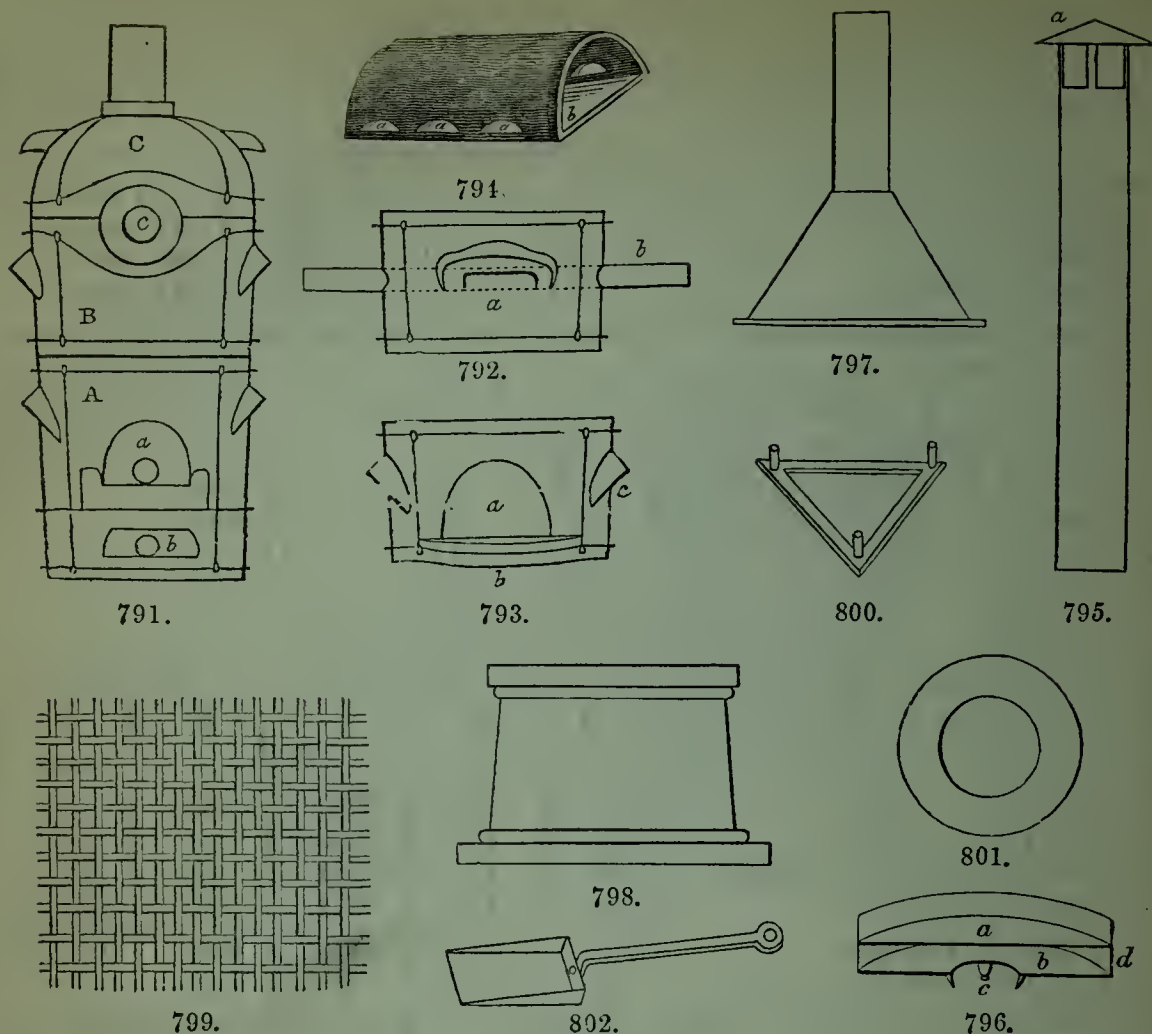
PRICES OF LUHME'S FURNACES.

Furnaces with Short Feet.	No. 1.	2.	3.	4.	5.
773. The Body.	22s.	28s.	35s.	56s.	72s.
774. The Dome.	6s.	10s.	15s.	15s.	18s.
775. Deep Sand-bath and Jacket.	6s.	10s.	15s.	15s.	18s.
776. Flat Sand-bath.	8s.	12s.	15s.	18s.	18s.
777. Complete Furnace.	42s.	60s.	80s.	104s.	126s.
778. Side-doors for Tube, extra.	3s.	3s.	3s.	3s.	3s.
Furnaces with Long Legs.	No. 1.	2.	3.	4.	
779. The Body.	47s.	52s.	64s.	85s.	
780. The Dome.	15s.	18s.	20s.	20s.	
781. Deep Sand-bath and Jacket.	15s.	15s.	18s.	18s.	
782. Flat Sand-bath.	15s.	18s.	18s.	20s.	
783. Complete Furnace.	92s.	103s.	120s.	143s.	
784. Side-doors for Tube, extra.	3s.	3s.	3s.	3s.	

Fire-clay Furnaces.

790. UNIVERSAL TABLE FURNACE, English fireclay, bound with iron wire, adapted for experiments with charcoal, or charcoal mixed with coke; consisting of the twelve articles, Nos. 791 to 802, which are supplied in a set, or separately at the prices affixed to each article. The price of the complete set is 40s.
791. The Reverberatory Furnace, in three pieces, Fig. 791, A, B, c; height 20 inches, diameter of fire-room, 7 inches, 16s.

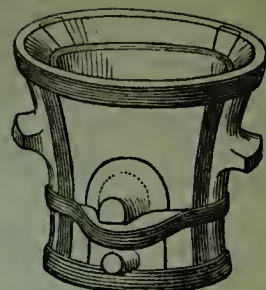
The piece A may be used separately as an evaporating or boiling furnace. It has an iron grate. *a* is the fire-door, *b* the ashpit. When the furnace is used for crucible operations, it is built up as shown by the Fig., and is surmounted by the chimney Fig. 795. When used for distillation, the neck of the retort is passed out at the door *c*, and the body of the retort is rested on two iron bars, placed in notches on the top of the piece A.



792. Tube Ring for the Universal Furnace, Fig. 792, for use instead of the middle ring B, Fig. 791, when the furnace is to be used for heating tubes of iron or porcelain, 3s.
793. Muffle Ring, Fig. 793, for use when the Universal Furnace is to be used for assaying by the cupel. 3s. 9d.
794. Muffle, to fit the Muffle Ring; size, 7 by $3\frac{1}{2}$, by $2\frac{1}{2}$ inches, 2s.
795. Iron Chimney, Fig. 795, for use with the reverberatory furnace when a high temperature is required for crucible operations, 3 feet high, 4 inches diameter, with dome to prevent mischief from the scattering of sparks, 3s.
796. Double-bottomed Iron Sand-bath, with holes for ventilation, adapted to the piece A of the furnace, Fig. 791, 15 inches diameter, 4s.
797. Iron Blower, Fig. 797, adapted to the evaporating furnace A, used to raise the heat of the fire, 2s.
798. Furnace Base, Fire-clay, Fig. 798, 8 inches high, on which to place the furnace, in order to prevent its burning the table, 3s. 6d.
799. Iron Trellis, 10 inches square, $\frac{1}{4}$ -inch meshes, strong iron wire, Fig. 799, for supporting flasks and basins over the evaporating furnace, 1s.
800. Cast-Iron Trivet or Triangle, Fig. 800, for supporting basins, retorts, flasks, &c., over the evaporating furnace, 8-inch sides, 9d.
801. Pair of Flat Iron Rings, Fig. 801, for supporting basins, &c., over the evaporating furnace; size of openings, 4 and 6 inches, 1s.
802. Iron Shovel, Fig. 802, for feeding the furnace with fuel, 1s.

803. FRENCH FIRE-CLAY EVAPORATING FURNACES, with ash-pit door, fire-door for inserting fuel, and grooves for ventilation cut in the top, as shown by Fig. 803; bound with iron hoops.

No.	Inside Diameter.	Price.	No.	Inside Diameter.	Price.
803. 5	to 5½-inch	5s.	807. 10-inch	.	11s.
804. 6	„ 6½ „	5s. 6d.	808. 10½ to 11 inch	.	14s.
805. 7	„ 7½ „	8s.	809. 11½-inch	.	16s.
806. 8¼	„ 8¾ „	9s.	810. 13 „	.	18s.



803.

These furnaces can be conveniently heated by gas, the ring burners No. 930 to 934 being put in the place of the usual grate.

811. FRENCH FIRE-CLAY EVAPORATING FURNACES, with ash-pit door, but without fire-door, with one long handle, like Fig. 811, or two ears like Fig. 803, bound with iron hoops.

No.	Inside Diameter.	Price.	No.	Inside Diameter.	Price.
811. 4½-inch	.	3s.	814. 7½-inch	.	4s. 6d.
812. 5 „	.	3s. 6d.	815. 8½ „	.	5s.
813. 6 „	.	4s.	816. 9½ „	.	5s. 6d.



811.

817. FURNACE FOR RETORTS, EVAPORATING BASINS, OR STILLs, French fire-clay, in one piece, similar to an evaporating furnace, but having a small chimney on the side to preserve the draught when the top is closed by the vessel, Fig 817.

No. 3. Fire-Room. 7½ inches wide, 9 inches deep, 20s.

No. 4. Fire-Room, 9 inches wide, 10 inches deep, 27s.

This furnace can be heated by gas instead of charcoal, use being made of the rings for burners, described at No. 930.

818. FRENCH FIRE-CLAY REVERBERATORY FURNACES, in three pieces, form of Fig. 818, page 78, but bound with iron hoops instead of wires.

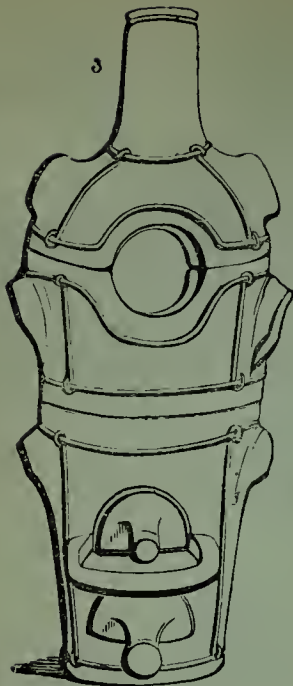


817.

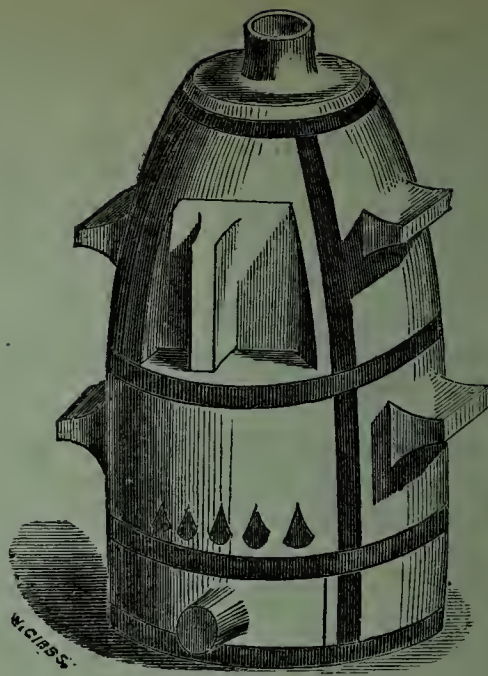
No.	Inside Diameter.	Price.	No.	Inside Diameter.	Price.	No.	Inside Diameter.	Price.
818. 4½ inches	.	10s. 6d.	823. 9¼ inches	.	25s.	827. 13½ „	.	42s.
819. 5¼ „	.	12s.	824. 11 „	.	28s.	828. 14¼ „	.	50s.
820. 6¾ „	.	15s.	825. 12 „	.	30s.	829. 16 „	.	56s.
821. 7¼ „	.	17s.	826. 13 „	.	36s.	830. 17½ „	.	60s.
822. 8¼ „	.	21s.						

831. MELTING FURNACES, Fire-clay, form of Fig. 831, page 78, London-made. †

No.	Height. Outside.	Diameter Inside.	Price.	No.	Height Outside.	Diameter Inside.	Price.
831. 19 inches,	6¼ inches	.	25s.	836. 26 inches,	9½ inches	.	63s.
832. 19½ „	6¾ „	.	32s.	837. 28 „	10¾ „	.	75s.
833. 21¼ „	7¼ „	.	38s.	838. 30 „	12 „	.	88s.
834. 22¼ „	7½ „	.	44s.	839. 32 „	12¾ „	.	100s.
835. 25¾ „	8¾ „	.	57s.				



818.



831.

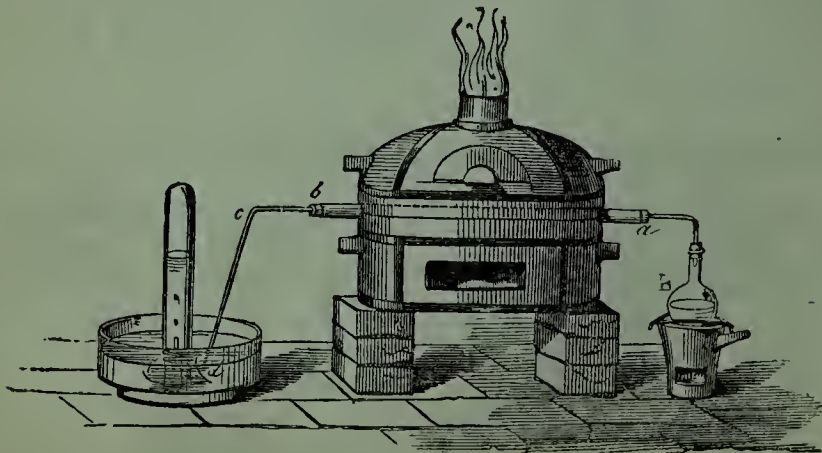
840. AIR FURNACES, for fusions, nearly of the form of Fig. 831, French fire-clay.

No.	Height.	Outside Diameter.	Diameter of Fire-Room.	Price.
840.	13 inches.	5½ inches.	4 inches.	18s.
841.	16 "	7½ "	5½ "	25s.
842.	18 "	8½ "	6 "	33s.
843.	20 "	9½ "	7 "	45s.
844.	30 "	13 "	10 "	60s.

845. Furnace for Dentists, oval form, Fire-clay, London-made; interior diameter, 14 inches by 10½ inches; height from bars, 24 inches; total height, outside, 32 inches, £5.

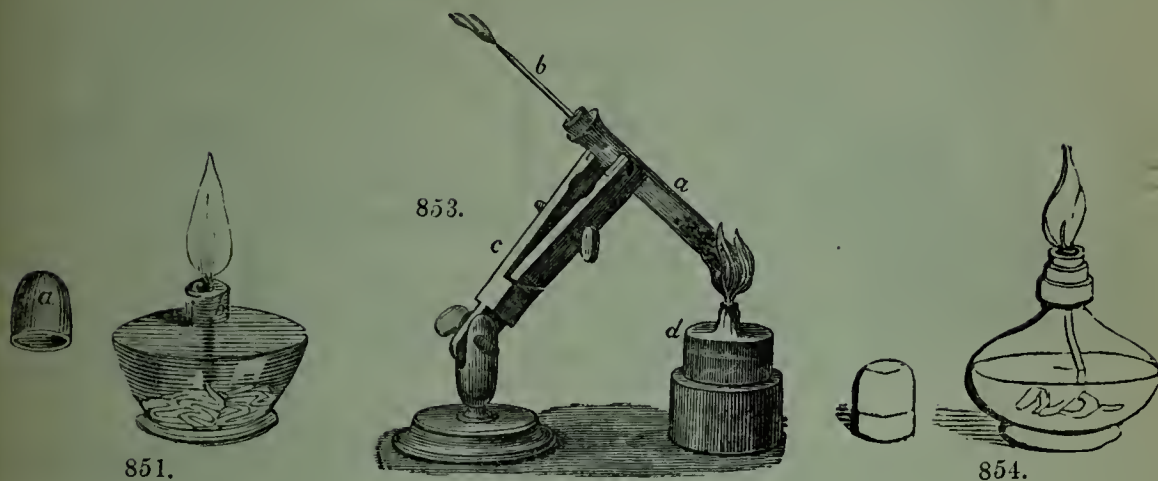
846. REVERBERATORY FURNACE FOR HEATING TUBES, French fireclay, form of Fig. 846; length where the tube is inserted, 15½ inches, outside; fire-room, 12½ by 6½ inches, 33s.

Other furnaces for heating tubes will be described under the heads of "Gas Furnaces" and "Organic Analysis."



846.

SPIRIT LAMPS.



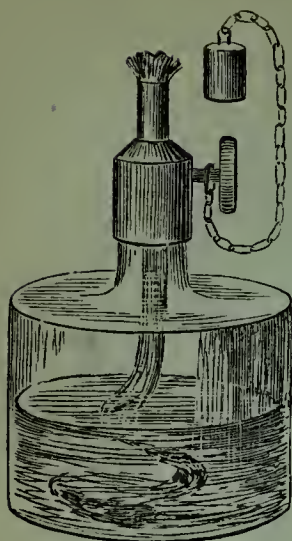
A. SIMPLE SPIRIT LAMPS.

851. GLASS SPIRIT LAMPS, with Ground Glass Caps and Incorrodible Stoneware Wick-holders. Form of the Lamp, either conical, like Fig. 851, or cylindrical, like Fig. 853 *d*. Four sizes, namely, 1, 2, 3, and 4 ounce capacity, each 1s.
852. Ditto, ditto, larger sizes, 5, 6, 7, and 8 ounces capacity, each 1s. 4d.
854. Spherical-shaped Glass Spirit Lamps, with foot, form of Fig. 854, and sometimes flatter. 5-ounce size, 1s. 6d.

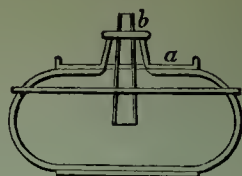
The Stoneware Wick-holders have, over those made of brass, the advantage of not being acted on by the acid which usually accompanies the wood naphtha. Consequently, they do not give a green flame, nor deposit copper upon platinum vessels placed in the flame; neither do they convey heat to the spirit in the lamp, and cause it to boil so readily as do the brass wick-holders.

855. Glass Spirit Lamps, with White Porcelain Wick-holders, at 2d. each above the prices of Nos. 851 and 852.
856. Glass Spirit Lamps, with Brass Wick-holders, slight make, at 2d. each above the prices of Nos. 851 and 852.
857. Glass Spirit Lamps, with solid Polished Brass Screw Wick-holders and Glass Caps, 2 to 4 ounce, each 2s.
858. Ditto, 5, 6, 7, and 8 ounce, each 2s. 6d.
859. Spirit Lamps, with an extra stoppered neck for supplying spirit when required, Fig. 859, best German Glass. *a*. Cylindrical, 6-ounce; *b*. Globular, on foot, 5-ounce; each 2s. 6d.
860. Glass Spirit Lamps, 8-ounce size, with Brass Wick-holder, rack and pinion to raise and lower the wick as required, and brass cap, Fig. 860, 2s. 6d.
861. Round Plaited Cotton Wick, for the Spirit Lamp No. 860, per yard, 6d.
862. Embossed Stoneware Spirit Lamp, with Stoneware Wick-holder and Cap, Fig. 862, 8d.
863. Cotton Wick, flat, $\frac{1}{2}$ inch wide, for Spirit Lamps, per dozen yards, 1s.
864. Ditto, per single yard, 1 $\frac{1}{2}$ d.
865. Iron Chimney for Small Spirit Lamps, to steady the flame, Fig. 865, 3d.





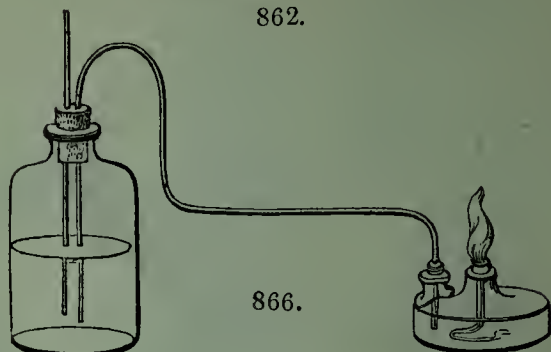
860.



862.



865.



866.

866. Spirit Lamp, 6-ounce size, with two necks, and pint flask, with syphon for the continuous supply of spirit, Fig. 866, 4s.

Another method of supplying oil or spirit to lamps is described in the account of Charles Griffin's Oil Lamp, No. 912.

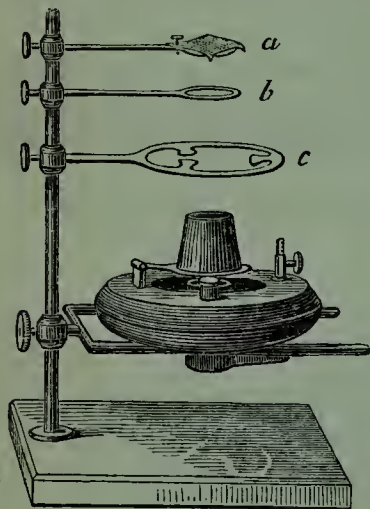
B. ARGAND SPIRIT LAMPS FOR HEATING CRUCIBLES.

BERZELIUS'S ARGAND SPIRIT LAMP, mounted on a Stand, for supporting Crucibles, &c. Newest patterns, Berlin manufacture; Polished Brass Lamps, Brass Rod and Fittings, and Mahogany Foot, as represented by Figs. 870, 871, 872, and 873, at the following prices:—

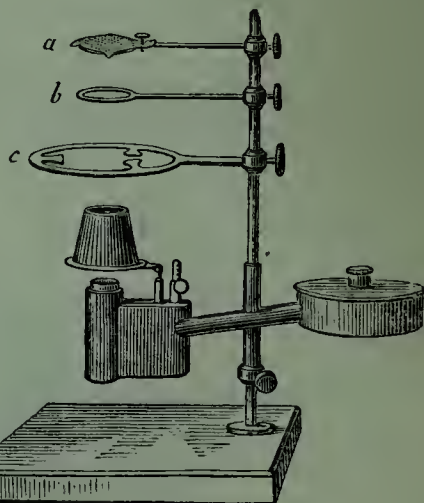
870. Spirit Lamp, with the Spirit-holder surrounding the Wick-holder, 16s. 6d.

871. Spirit Lamp, with the Spirit-holder separated from the Wick-holder, 16s. 6d.

872. Spirit Lamp, with the Spirit-holder separated from the Wick-holder, but surrounding the Brass Rod, 16s. 6d.

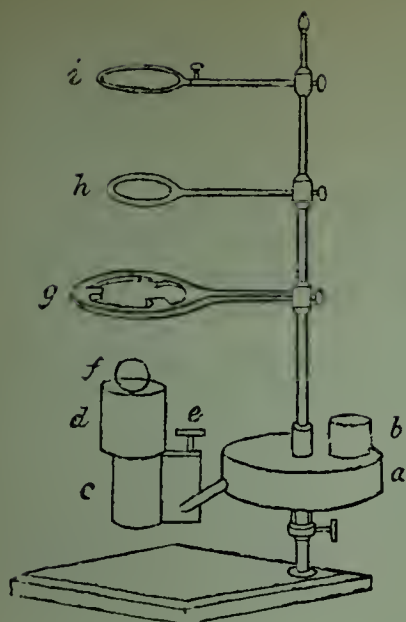


870.

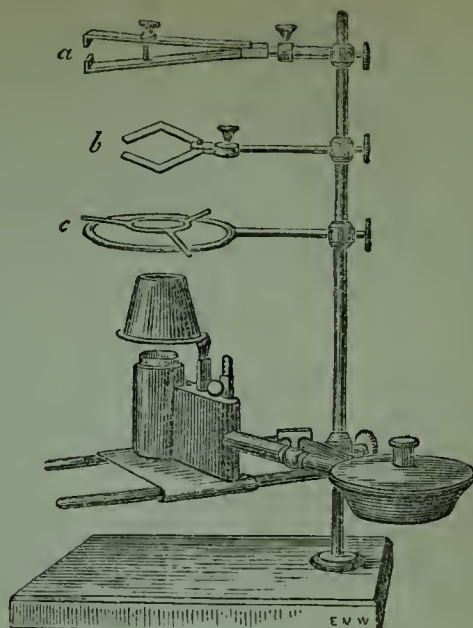


871.

873. Spirit Lamp, with the Spirit-holder separated from the Wick-holder, and having a Stopcock and extra Fittings, as represented in Fig. 873, 20s.



872.



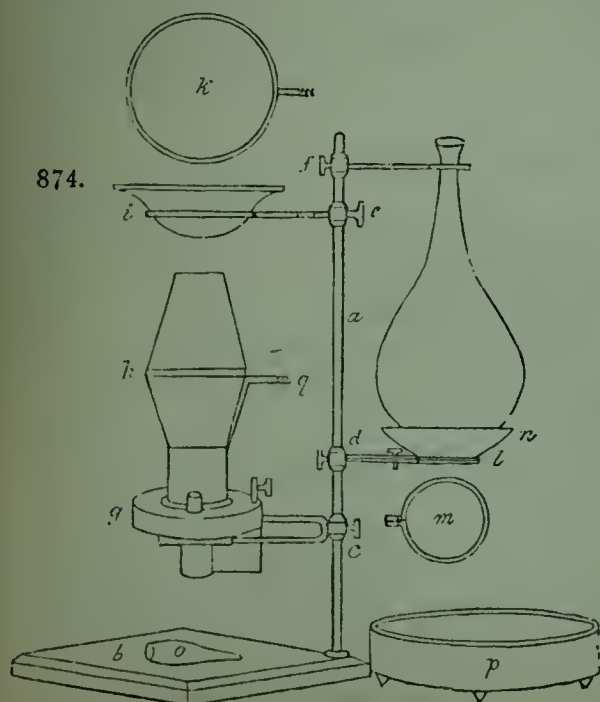
873.

874. Spirit Lamp, with the Spirit-holder surrounding the Wick-holder, like No. 870, but having the extra Metal Fittings that are represented in Fig. 874 (omitting the glass and pottery), 25s.

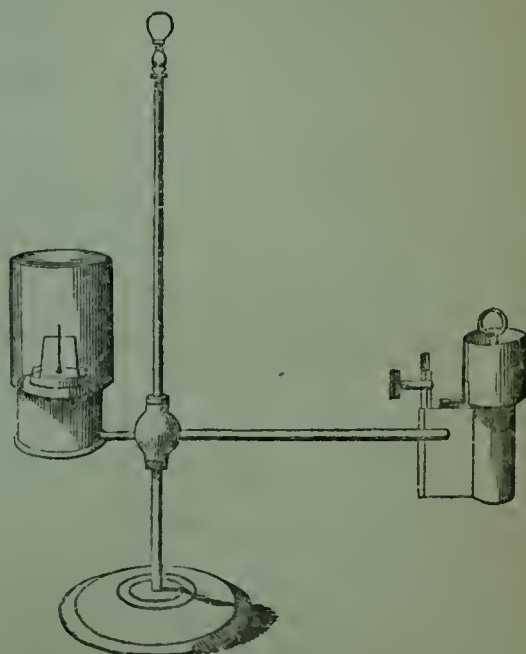
A brass rod, *a*; polished mahogany foot, *b*; brass fork to support lamp, *c*; brass vice, *d*, to hold iron rings, of which there are two, *l* and *m*; a socket and screw, *e*, to hold brass rings, of which there are also two, *i* and *k*; a brass ring, with thumb-screw, *f*, to steady tall vessels; an iron crucible jacket, with a screw, *g*, adapted to the socket *e*; a tinplate sand-bath, *n*; a glazed pan, *p*; a lamp-stick, *o*.

875. Mitscherlich's Spirit Lamp, in which the spirit is supplied to the Wick-holder, from a Glass Fountain Spirit-holder, attached to the same stand, at a distance of 9 inches, Fig. 875, 21s.

The brass fittings of these lamps are all made very slender, in order not to carry off too much heat. When it is necessary to heat very heavy vessels, other supports must be used, the lamp being kept on its own slender standard.



874.



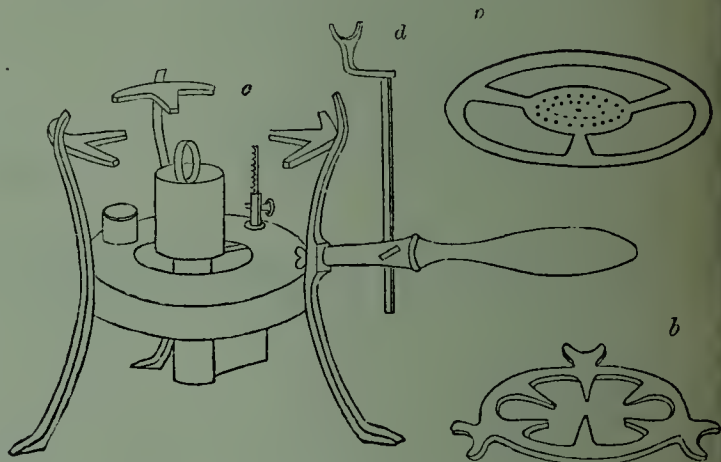
875

876. Lamps of the above patterns, if mounted on a porcelain foot, cost 3s. 6d. extra.
877. Unmounted Porcelain Foot for a Lamp Support. 7 by 7 inches, 2s. 6d.
878. Ditto, 8 by 6 inches, 2s. 6d.
879. Ditto, 11 by 8½ inches, 4s. 6d.
880. Wicks for the Argand Spirit Lamps, per dozen, 6d.
882. Short Iron Support (Rod and Foot), to hold an Argand Spirit Lamp under an evaporating basin when placed on a low tripod, 1s. 3d.

C. ARGAND SPIRIT LAMPS ON TRIPOD STANDS.

For the ignition of crucibles, it is usual to mount the lamp on a slender support that will not carry away so much of the heat as to lessen its intensity too greatly; but for boiling and evaporating, it is convenient to have the lamp on a lower and more solid support, such as is represented in Fig. 889, a brass tripod with wooden handle.

885. Brass Lamps, lacquered, brown colour, with one iron ring, 7s. 6d.
886. Ditto, larger size, with one iron ring, 9s.
887. Brass Lamps, polished, larger and stronger than the lacquered lamps, with one brass ring, *a*, and one iron ring, *b*, as shown in Fig. 889, 16s. 6d.
888. Ditto, larger size, 21s.
889. Massive Brass Spirit Lamp, with the fittings represented by Fig. 889, 30s.



889.

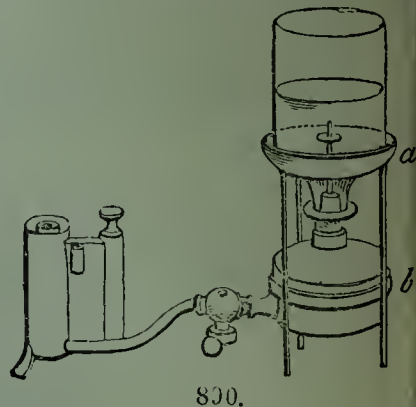
D. BLAST SPIRIT LAMPS.

Apparatus for the Continuous Action of Argand Spirit Lamps.

When a spirit lamp acts with a blast of air, either for glass-blowing or for the decomposition of siliceous minerals, the quantity of spirit held in a lamp of the usual size is soon exhausted, and it is convenient to have the means of renewing the supply without suspending the operation. Either of the following plans may be adopted.

Fig. 890 represents a lamp to which the frame *a b* is attached. The ring *b* sits on the spirit-holder of the lamp. The ring *a* supports an inverted spirit flask, in the neck of which a valve is fixed. From this flask the spirit runs into the lamp when the rod of the valve touches the bottom of the lamp, and the spirit is so low there as to permit air to pass up into the flask.

890. Price of the frame and a pint bottle, fitted, 6s.
891. Modification of the above, in which the frame is dispensed with, and the spirit reservoir is adjusted to the lamp by a block of boxwood, 5s. 6d.
892. Spirit Reservoir, consisting of a metal can, mounted on three legs, and provided with a stopcock and a long delivery pipe, by which spirit can be delivered continuously, in drops or in a stream, either to feed Argand lamps, or such as are represented at No. 866, quart size, 5s.

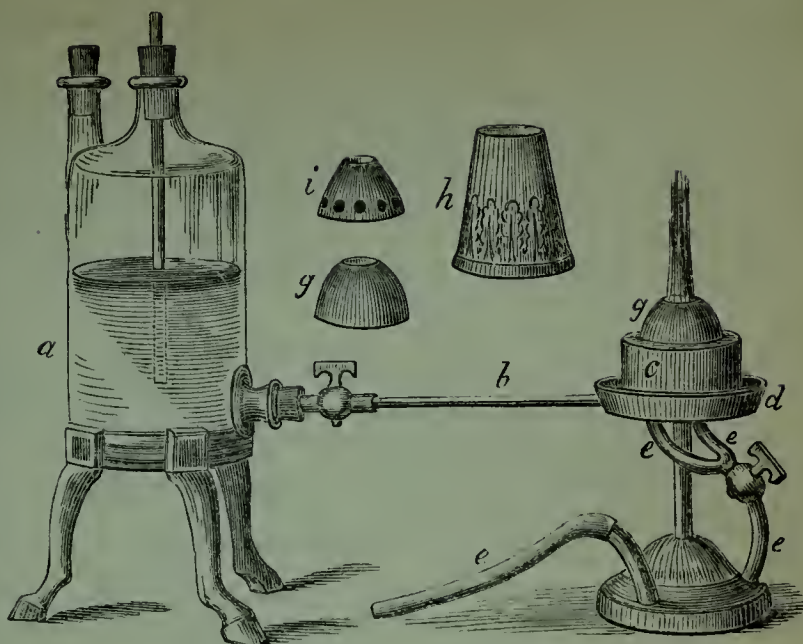


890.

This apparatus is represented by *a* in the woodcut of Charles Griffin's Oil-Lamp Furnace, No. 912.

893. Deville's Blast Lamp, for producing a very high degree of heat by burning turpentine vapour mixed with a current of atmospheric air supplied by a blowing apparatus. Price 42s.

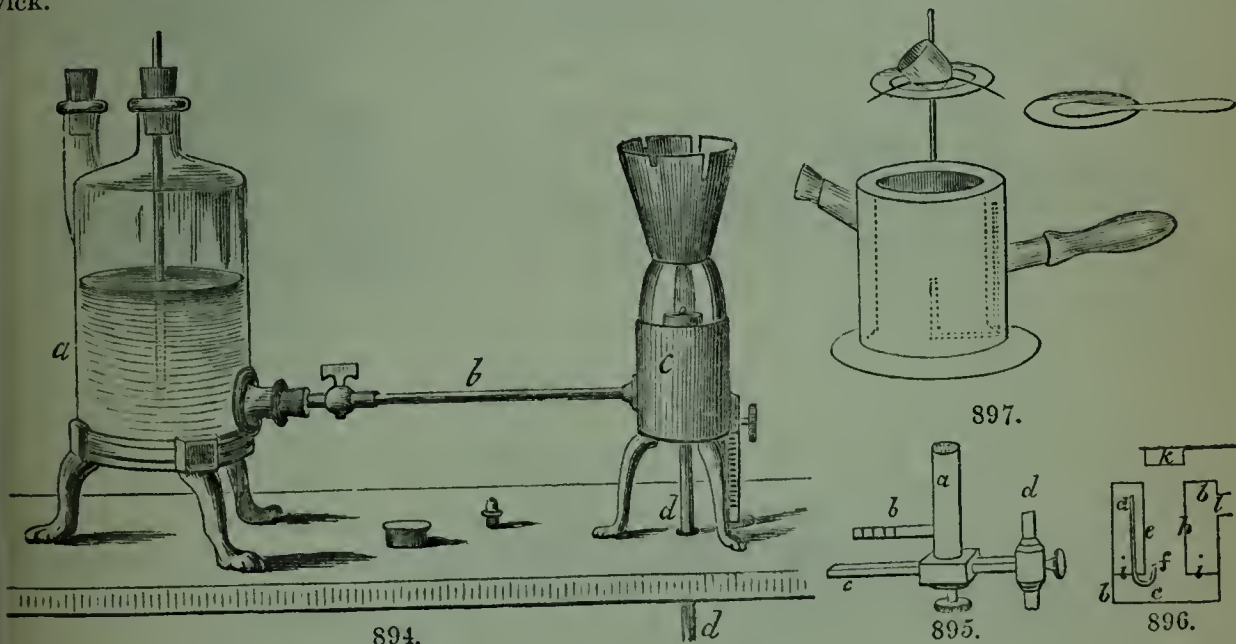
The apparatus is represented by Fig. 893 at about one-fifth of the actual size. It is described in detail in *Chemical Recreations*, page 583. The turpentine is contained in the vessel *a*. The blast is conveyed by the pipe *e*. The copper pieces *g*, *h*, *i* are used, to modify the flame. The largest piece, *h*, is that on which crucibles are to be supported by means of a triangle of platinum wire. This lamp acts without a wick.



893.

894. Blast Spirit Lamp, for burning a mixture of alcohol and turpentine with a blast of atmospheric air, Fig. 894. Price 28s.

Described in *Chemical Recreations*, page 585. The vessel *a* contains the mixed spirits. The cylinder *c* contains an Argand wick. The blast of air is supplied by the pipe *d*, which comes up through the table. This blast pipe can be fixed at different heights, and be supplied with jets of different sizes, to suit the regulated supply of spirit, and the height of the exposed portion of wick.



894.

897.

895.

896.

895. Multiple Blowpipe, for use with any of the Argand Spirit Lamps, to enable them to raise heat sufficient to fuse several hundred grains of carbonate of soda, or a few ounces of copper, Fig. 895. Price 5s. 6d.

This blowpipe belongs to Charles Griffin's Thermogenic Oil-Lamp, described in No. 912, in a subsequent section. It is represented here as mounted on the support of a spirit lamp. *a* is the multiple blowpipe, which can be passed up inside the wick-holder of a lamp to a height depending upon the height of the wick and the degree of heat required. The blast of air enters by the tube *b*; *d* is the rod of the spirit lamp support, and *c* a square bar upon which the position of the blowpipe can be adjusted. The air is supplied by a glass-blower's bellows, or any other blowing machine. This form of

blowpipe is easily managed, and very effective; more so than Plattner's apparatus, which consists of five blowpipes, arranged in a circle around the wick, for it is difficult to get the separate five blowpipes to act uniformly. By a sufficient exposure of cotton wick, a good supply of spirit, and a regular blast of air, a powerful heat can be obtained with the use of this blowpipe. But, in point of fact, a brass Argand spirit lamp is not a suitable instrument for producing very high temperatures; for when you succeed in heating a crucible by means of it to whiteness, the crucible in its turn heats the lamp and the spirit. The lamp melts or burns, and the spirit boils, takes fire, and produces a larger flame than you wish for. These difficulties are avoided by the use of a lamp constructed on the principle of Charles Griffin's Oil Lamp, which is described in the following section. Argand spirit lamps answer well for producing a good red heat; but when a white heat is wanted, they are neither handy nor economical.

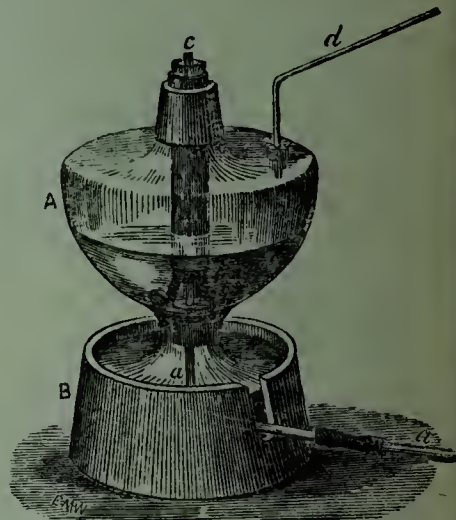
896. Russian Spirit Lamp, well adapted for all purposes where a powerful heat is required for a short time, as in igniting Platinum or Porcelain Crucibles, bending Glass Tubes, &c. Size, $2\frac{1}{2}$ inches high, and $2\frac{1}{2}$ inches diameter, Figs. 896 and 897. 9s.

897. Large Russian Spirit Lamp, 5 inches high and 5 inches diameter, 18s.

This Lamp consists of a body, *b, b*, having a false side, *e, h*, and partial false bottom, *i, i*, as seen in Fig. 893, so fixed as to enclose a space, *b, d*, which has no communication with the inner space *c*, except by the bent tube, *d*, which terminates in a fine orifice at *f*. The cover, *k*, serves as a measure, and being filled with either alcohol or pyroxylic spirit, is emptied into the inner space, *b, d*, by aid of a funnel, through the opening, *l*, which is then securely closed by a good cork. The same measure of spirit is introduced into the space *c*, and kindled. The spirit in *c* by burning soon boils that in the space, *b, d*, and the vapour is forced with considerable violence through the tube *d*, becomes ignited at *f*, and produces a continuous column of burning vapour 6 inches high, which will last from twelve to sixteen minutes. The cover, *k*, will serve as an extinguisher when required, by merely placing it over the space, *c*.

A ring or triangle, kept in its situation by the screw at the side, may be adjusted to any height, and serves to hold crucibles while being heated. During a process the neck *l*, with its cork, should be so placed, that if the cork is violently expelled it can strike nothing to harm it.

901. Mitscherlich's Ether Lamp, fed with a blast of oxygen gas, by the flame of which platinum and quartz can be melted, Fig. 901. See *Chemical Recreations*, page 189. 6s.



901.

OIL LAMPS.

A. OIL LAMPS FOR BOILING AND EVAPORATING.

905. Small Oil Lamp, of saltglazed stoneware, with stoneware wick-holder, cover, and cup to catch overflowing oil, Fig. 905, suitable for slow evaporations, 8d.

906. Similar Lamp, of white glazed Berlin porcelain, 1s.

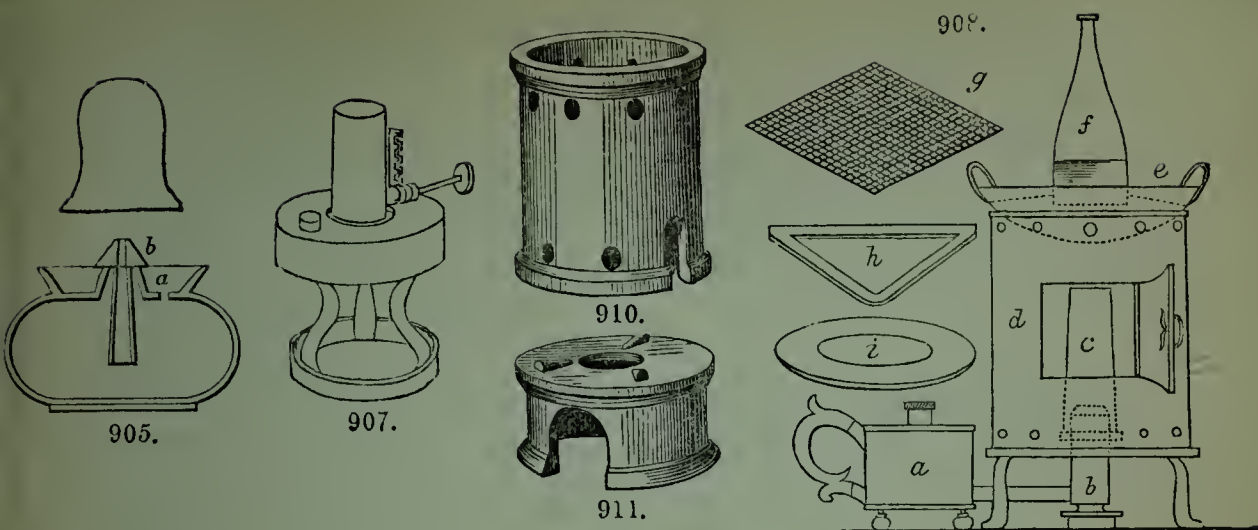
907. Argand Oil Lamp, japanned tin plate, on tripod stand, Fig 907, with copper chimney:

No. 1.	5s.		No. 2.	6s. 6d.		No. 3.	8s.
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908. Large Lamp Furnace, for boiling or distilling, or the evaporation of bulky solutions. Copper solar oil lamp, iron stool, tin-plate cylinder, sand-bath, and 3 tops, *g, h, i*, as represented in Fig. 908, 25s.

909. The Solar Oil Lamp separately, 16s.

910. Cylinder of Saltglazed Stoneware, for use with the solar lamp instead of the tin-plate cylinder depicted in Fig. 908, 10 inches high, 9 inches in diameter, 3s.

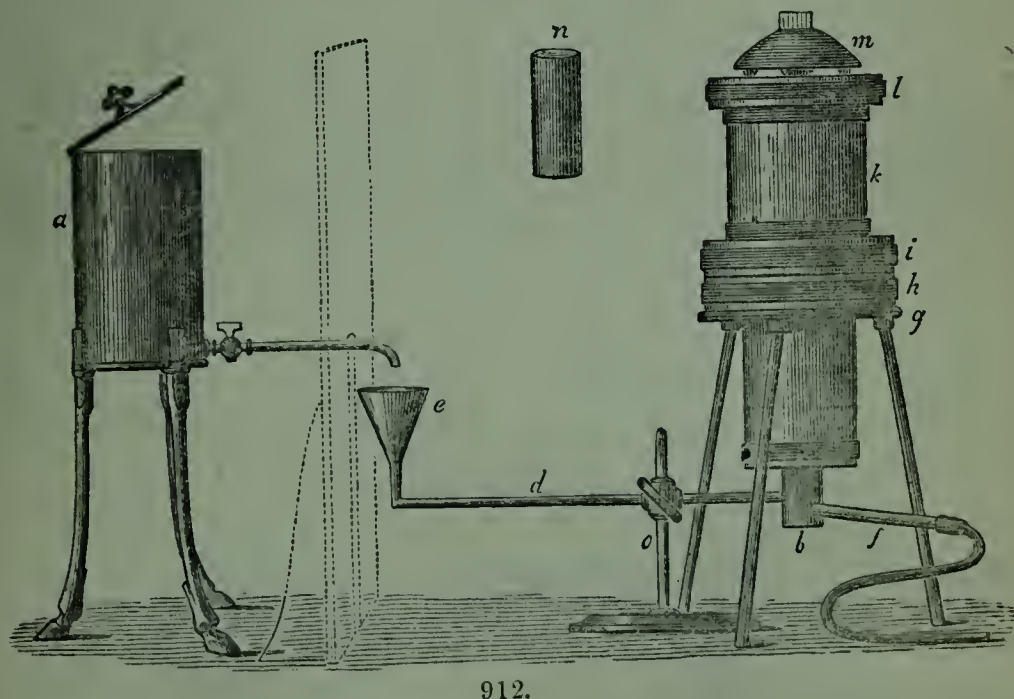


911. Foot of Saltglazed Stoneware, size 9 inches diameter, $4\frac{1}{2}$ inches high, adapted to adjust the cylinder No. 910 properly over the Solar Lamp, No. 908, 2s.

The slit represented in Fig. 910 is to admit a gas-pipe, when gas instead of oil is employed with this evaporating furnace.

B. GRIFFIN'S OIL-LAMP FURNACE, FOR MELTING METALS AT A WHITE HEAT.

The Oil-Lamp Furnace rivals a spirit lamp in handiness and cleanliness, and a blast gas furnace in economy and power. It produces neither smoke, nor soot, nor ill odours. It is so compact, that it may stand on a tea-tray while melting eighty ounces of iron; and it requires no chimney. The first cost of the apparatus and the current expense for oil are mere trifles.



912.

912. THE GUINEA FURNACE—This furnace serves for all chemical operations in platinum and porcelain crucibles, and for all metallurgic fusions in small fire-clay or plumbago crucibles. It will melt a pound of cast iron in twenty-five minutes at a cost of 2d. for oil. It comprises all the articles shown in the above figure.

913. THE GUINEA-AND-A-HALF FURNACE.—This furnace does all the work of the guinea furnace, and, in addition, is provided with furnace bodies and crucibles for operating on larger quantities of metal. It will melt five pounds of cast iron in sixty minutes, at a cost of 9d. for oil.

914. Extra Grates for the oil-lamp furnaces, each, 1s. 6d.

915. Cotton Wicks for the lamp, per dozen sets of three wicks, 2s. 6d.

The price of extra clay cylinders will be found at No. 1035.

Blowing Machines suitable for this Furnace are described in the section on "Blowing Machines."

Account of an Oil-Lamp Furnace, for Melting Metals at a White Heat.

By CHARLES GRIFFIN.

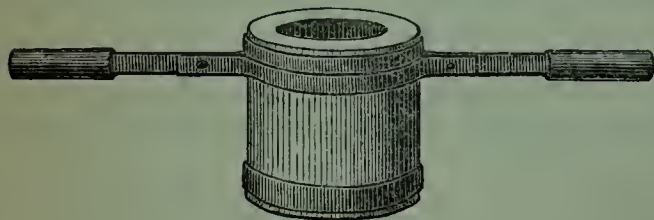
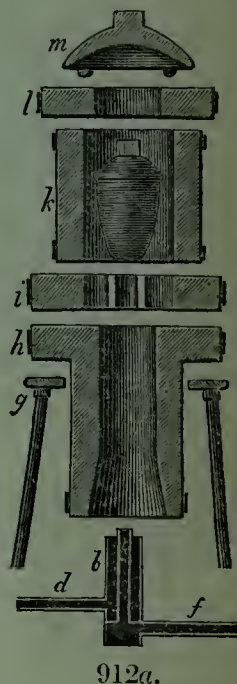
(From the CHEMICAL NEWS of JANUARY 2, 1864.)

I have been for some time engaged in experiments on the construction of chemical lamps. My object was to discover a method by which chemists and metallurgists, who have occasion to melt metals at a white heat, but who happen to have no command of coal-gas, may be enabled to accomplish their purpose by other agents. After many trials, I have contrived an oil-lamp which is not only as powerful in action as the best gas furnaces, but almost rivals them in handiness and economy.

Description of the Apparatus.—The Oil-Lamp Furnace is represented in perspective by Fig. 912, and in section by Fig. 912a. It consists of a wick-holder, an oil-reservoir, and a fire-clay furnace. To these must be added, a blowing-machine for the supply of atmospheric air.

The oil-reservoir is represented at letter *a*. It is made of japanned tinplate, mounted on iron legs, and fitted with a brass stopcock and delivery-tube. Its capacity is a little more than a quart. The wick-holder is represented at letter *b*, and the upper surface of it by the separate figure *c*. The wick-holder and the oil-reservoir are consequently detached. *d* is a tube which brings oil from the funnel *e*, and *f* is a tube to be placed in connexion with the blowing apparatus. The wick-holder contains three concentric wicks, placed round the multiple blowpipe *c*, which is in communication with the blowing tube *f*.

The crucible furnace consists of the following parts:—*g* is an iron tripod; *h* is a flue for collecting and directing the flame. This flue is of such a width, that when the wick-holder *b* is pushed up into it until the top of the wick is level with the top of the clay cone, there remains a clear air-space of about $\frac{1}{8}$ inch all round between the wick-holder and the cylindrical walls of the flue.—*i* represents a fireclay grate, having three tongues, shown by *i*, the separate figure of its upper surface. These tongues support the crucible, without stopping the rising flame.—*k* is a fire-clay cylinder, which rests upon the grate *i*, and encloses the crucible, forming, in fact the body of the furnace. Of this piece there are three sizes: the smallest is of 3 inches bore, and works with crucibles that do not exceed $2\frac{3}{4}$ inches diameter; a middle size, 4 inches bore, for crucibles not exceeding $3\frac{1}{2}$ inches



p.



c.



i.

diameter; the largest size, 5 inches bore, for crucibles not exceeding $4\frac{3}{4}$ inches diameter. This piece being heavy, is provided with handles, as represented in figure *p*. The walls of these

cylinders are from 1 inch to $1\frac{1}{2}$ inch thick.—*l* is a flat plate of fire-clay, with a hole in the centre, used to cover the cylinder *k*, so as to act like a reverberatory dome; *m* is a cover which prevents loss of heat from the crucible by radiation, but gives egress to the gaseous products of the combustion of the oil; *n* is an extinguisher to put over the wick-holder when an operation is ended; and *o* is a support for the wick-holder.

No chimney is required.

Management of the Oil-Lamp Furnace.—The apparatus is to be arranged for use as it is represented by Fig. 912. The cylinder *k* is to be selected to fit the crucibles, and the crucible of a size to suit the quantity of metal that is to be melted. 1 lb. of iron requires the smallest of the three cylinders, described above; $1\frac{1}{2}$ lb. the middle size; 5 lb. the largest size. The air-way between the crucible and the inner walls of the cylinder should never exceed $\frac{1}{4}$ inch, nor be less than $\frac{1}{8}$ inch.

The cotton wicks must be clean, and be trimmed a little below the level of the blowpipe *c*. If properly managed, they do not readily burn away, but can be used for several fusions. The reservoir should be filled with oil for each operation. The proper sort of oil for use is the more volatile kind of mineral oil, of the specific gravity of .750, which is now easily procurable at about 3s. per gallon. The variety known by the commercial name of turpentine answers well. The combustion of a quart of this oil, costing ninepence, gives heat sufficient to melt 5 lb. of cast iron. Probably the lighter kinds of paraffin oil may be suitable, but I have not had an opportunity of trying them. Liquids of the alcohol class, spirits of wine, and pyroxylic spirit can be used; but they are less effective and more expensive than turpentine. Care must be taken not to spill the oil on the table or floor, and not to decant it carelessly in the neighbourhood of a light; because atmospheric air strongly charged with the vapour of these light oils is explosive. When the oil is burnt in the furnace, in the manner described below, there is no danger. During an operation, a wooden screen, as represented by the dotted lines in Fig. 912, should be placed between the oil-reservoir and the furnace, to prevent the vaporization of the oil by radiant heat.

As the wick-holder *b* and supply-pipe *d* contain only about one fluid ounce of oil, the oil must be run continuously, during a fusion, from the reservoir *a* into the funnel *e*, in order that the cotton may be always flooded. The success of the fusion depends upon the due supply of oil, to which point the operator must pay attention. At the commencement of a fusion, the oil must be run from the reservoir until the surface of the oil in the funnel has a diameter of about an inch. The wicks will then be flooded, and a light may be applied, and a gentle blast of air then set on. The oil immediately sinks in the funnel; and the stopcock must be opened, and so regulated as to keep the oil barely visible at the bottom of the funnel. If too much oil is supplied, it immediately rises in the funnel, and simultaneously overflows the wick-holder. Too much vapour is then thrown into the furnace, and the heat is immediately lowered, especially at the beginning of an operation, before the fire-clay portions of the furnace are well heated. If, on the contrary, too little oil is supplied, the wicks burn, and the operation is spoilt. The demand of the wick-holder for oil depends upon the condition of the furnace and the character of the fusion in progress. When the lamp is newly lighted and the furnace cold, the oil should be passed slowly, in distinct drops; but, as the furnace becomes hot, the rapidity of the supply of drops should be increased; and, finally, when the furnace is at a white heat, the oil should be supplied in a thin continuous stream. When the fusion to be effected is that of only a small quantity of metal, such as 1 lb. of iron, a rapid supply of drops of oil is sufficient even to the close of the operation. At that rate, the burner consumes about $1\frac{1}{4}$ pint of oil in an hour. When the fusion to be effected is that of 4 lb. or 5 lb. of iron, and the large furnace is in action and has been brought to a white heat, the supply of oil must, as stated above, be in a thin continuous stream, and the operation will then consume 2 pints of oil in the hour. And here it requires remark that, with that continuous supply, when the furnace is large and is at a white heat, the oil does not rise in the funnel, being instantaneously converted into gas at the mouth of the burner, and thrown up in that state into the furnace for combustion. The operation, indeed, consists, at that point, of a rapid distillation of oil-gas, which is immediately burnt, in the presence of air supplied at a suitable pressure by a dozen blowpipes, in effective contact with the crucible to be heated.

The flame produced in this furnace is as clear as that produced by an explosive mixture of air and coal-gas. It is perfectly free from smoke, and the unconsumed vapours which occasionally escape with the gaseous products of the combustion are even less unpleasant to smell and to breathe in than are those which are usually disengaged by a blast gas furnace, or by an ordinary lamp fed with pyroxylic spirit.

The contents of a crucible under ignition in this furnace can at any moment be readily examined, it being only necessary to remove the pieces *l* and *m* with tongs, and to lift the cover of the crucible, during which the action of the furnace is not to be interrupted.

When the operation is finished, the blast is stopped, the stopcock is turned off, the oil-reservoir is removed, the wick-holder is lowered on the support *o*, withdrawn from the furnace, and covered with the extinguisher *n*. The quantity of oil which then remains in the lamp is about one fluid ounce.

Power of the Oil-Lamp Furnace.—The furnace being cold when an operation is commenced, it will melt 1 lb. of cast-iron in 25 minutes, $1\frac{1}{2}$ lb. in 30 minutes, 4 lb. in 45 minutes, and 5 lb. in 60 minutes. These results have been obtained in my experiments. When the furnace is hot, such

fusions can be effected in much less time; for example, 1 lb. of iron in 15 minutes. It need scarcely be added, that small quantities of gold, silver, copper, brass, German silver, &c., can be melted with great ease, and that all the chemical processes that are commonly effected in platinum and porcelain crucibles can be promptly accomplished in the smallest cylinder of this furnace; and, in the case of platinum vessels, with this special advantage, that the oil-gas is free from those sulphurous compounds, the presence of which in coal-gas frequently causes damage to the crucibles.

Requisite Blowing Power.—The size of the blowing machine required to develop the fusing power of this Oil-Lamp Furnace depends upon the amount of heat required, or the weight of metal that is to be fused. For ordinary chemical operations with platinum and porcelain crucibles, and even for the fusion of 1 lb. of cast iron in clay or plumbago crucibles, a blowing power equal to that of a glass-blower's table is sufficient, provided the blast it gives is uniform and constant. But the fusion of masses of iron weighing 4 or 5 lb. demands a more powerful blower, such as is commonly used in chemical laboratories for the supply of air to blast furnaces when fed by gas or coke. The highest power of the Oil-Lamp Furnace depends, indeed, upon the power of the blowing-machine that is to be used with it. Much more than 5 lb. of iron can be melted by the gas which this Oil-Lamp is capable of supplying, provided a sufficiently powerful blowing-machine supplies the requisite quantity of air. When more than a quart of oil is to be rapidly distilled into gas, and the whole of that gas is to be instantly burned with oxygen, it is evident that effective work demands a large and prompt supply of air.

Cost of the Oil-Lamp Furnace.—As in all practical matters of this sort the *cost* is a main question, it may be useful to state that the price of this apparatus, complete, without the blowing machine, but including every other portion necessary for heating crucibles up to the size sufficient to fuse 1 lb. of cast iron, is *one guinea*; and that with the extra furnace-pieces for crucibles suitable for 5 lb. of iron, or any intermediate quantity, the cost is *a guinea and a half*.

GAS BURNERS AND GAS FURNACES.

920. GAUZE-TOP CYLINDER GAS BURNER, 4-inch brass cylinder, with 2-inch gauze top, iron foot, fish-tail jet, extra blowpipe jet, and wooden support for the hand, Fig. 920, but without stopcock, 6s.

921. Gas Burner, which can be used as an Argand burner, with metal chimney; as a gauze-top burner, and as a blowpipe jet; brass cylinder, $5\frac{1}{2}$ inches by $2\frac{1}{2}$ inches, iron foot, and porcelain Argand burner, 7s. 6d.

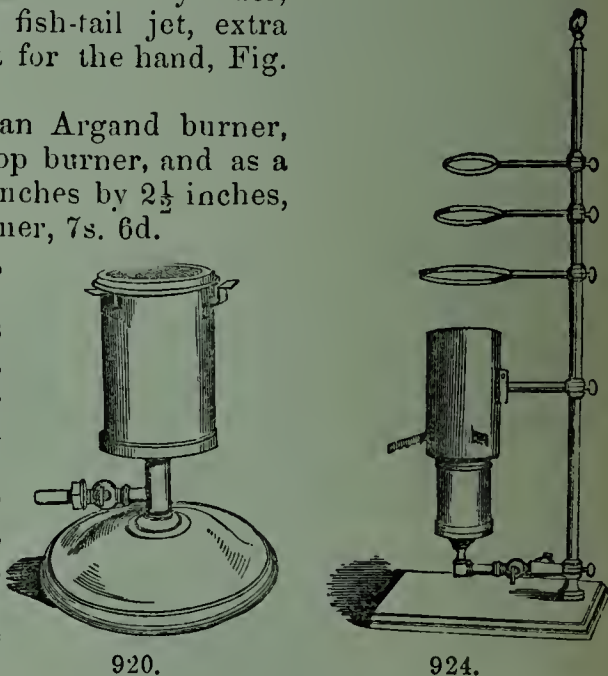
922. Stopcock to either of the above, 1s. 6d extra.

923. Hoffmann's Gas Burner, $5\frac{1}{2}$ -inch brass cylinder, with $2\frac{1}{2}$ -inch gauze top, porcelain Argand burner and blowpipe burner, with 3-way cock and iron foot, 10s. 6d.

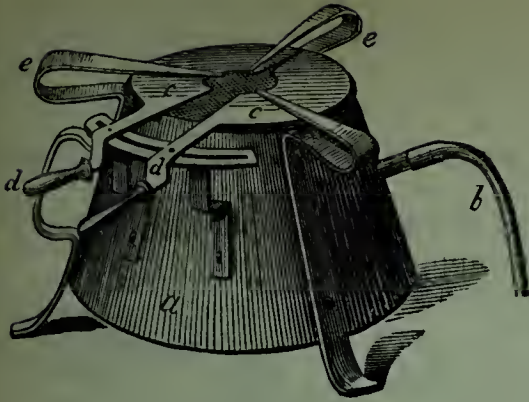
924. Gas Burner, cylinder with gauze top and stopcock, on a large retort stand, with rings and iron crucible jacket, Fig. 924, 20s.

925. Gas Boiling Apparatus, broad gauze top, with regulator and kettle support, Fig. 925, 20s.

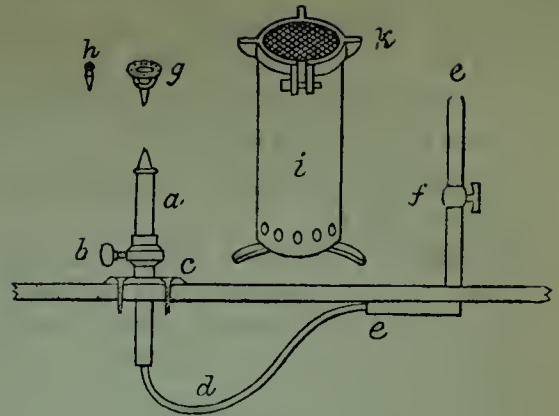
926. Gas Burner to fix to a Laboratory Table, Fig. 926, the set 14s.



This set consists of a brass tube, *a*, which can be screwed to a laboratory table by the flange *c*, and yet have the power to rise and fall, by means of the flexible pipe *d* and the clamp *b*. It has a brass cylinder, *i*, and gauze top, *k*; a single jet burner, shown in *a*; a ring or Argand burner, *g*, and a blowpipe burner, *h*. Letters *e* and *f* refer to the main gas-pipe and stopcock affixed to the wall of the laboratory. A sheet of metal about a foot square should be screwed to the table under the flange *c*.

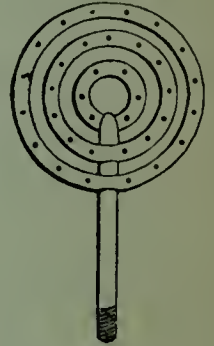
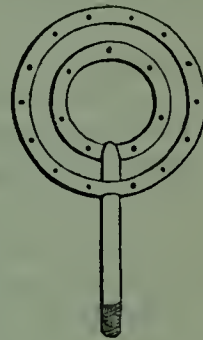
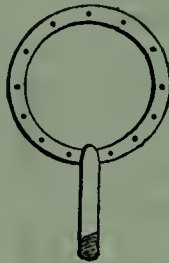
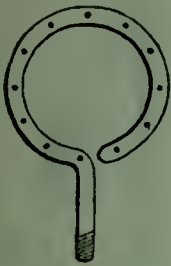


925.



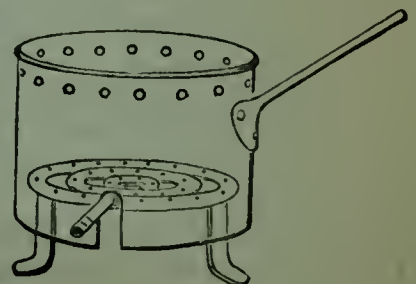
926.

RING GAS BURNERS, for producing diffused flames, suitable for boiling, evaporating, and the application of heat to large surfaces; consisting of bent iron pipes pierced with numerous holes, each of which supplies gas for a special flame. Several forms, as represented by Figs. 930 to 934. The pipes have a bore of $\frac{3}{16}$ inch, and the rings have the diameters quoted in the table.



Diameter of Ring.	930. Plain Ring.	931. Coil.	932. Brazen Ring.	933. Double Ring.	934. Triple Ring.
2 inch.	1s.	—	1s. 6d.	3s.	—
3 inch.	1s. 2d.	2s.	1s. 9d.	3s. 6d.	—
4 inch.	1s. 3d.	2s. 3d.	2s.	3s. 9d.	6s.
5 inch.	1s. 5d.	2s. 8d.	2s. 3d.	4s. 3d.	6s. 6d.
6 inch.	1s. 6d.	3s.	2s. 6d.	4s. 6d.	7s.
7 inch.	1s. 8d.	3s. 6d.	2s. 9d.	5s.	7s. 6d.
8 inch.	1s. 9d.	—	3s.	5s. 6d.	8s.

935. CYLINDRICAL IRON FURNACES FOR SUPPORTING BASINS AND OTHER VESSELS OVER THE RING GAS BURNERS, made of stout iron plate, of the form represented by Fig. 935, consisting of a cylinder, the top of which is 10 inches above the table. It stands on three legs, is open at the bottom, and is furnished with a handle. The three strips of metal that form the feet are continued upwards within the cylinder, and bent towards the middle, so as to form a tripod upon which the



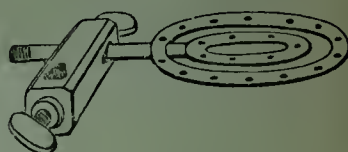
935.

ring burner rests, the leading tube passing out through a slit in the cylinder, to be put into connexion with the caoutchouc tube that brings the gas. The space between the ring burner and the top of the furnace is about 6 inches.

Two sizes of this cylinder:—

935. Six inches diameter, serves for Rings of any pattern from 2 inches up to 5 inches diameter, 4s.
 936. Nine inches diameter, serves for all the sizes of the Rings, so that by changing the ring any requisite degree of heat can be supplied, 5s.
 937. Block for attaching the Ring Gas Burners to a Retort Stand. See Nos. 277, 286.

a. Price of a suitable iron retort stand, the base rectangular, $9\frac{1}{2}$ inches long, 6 inches wide, the rod 28 inches long and $\frac{3}{8}$ inch diameter, and a block adapted to such a rod and to the diameter of the arm of the burners, 5s.



937.

b. If a stand with rings or other fittings is required, the price will be found between No. 260 and No. 280.

Triangles for supporting small vessels over these cylinders, are described at Nos. 299 to 308; Sand-baths in a subsequent section.

The French Furnace for Stills, &c., No. 817, or the Furnaces Nos. 803 to 810, can also be heated by these ring gas burners, instead of being fed with charcoal.

938. Deville's Collection of Gas Burners for various chemical operations, comprehending all the pieces shown in Fig. 938, £3 15s.

Description.—*a*, supply pipe with stop-cock; *b*, jet with circle of holes; *c*, single jet; *d*, flat jet for blowpipe; *e*, Argand, with gallery for chimney; *f*, Herapath's gas blowpipe; *g*, cylinder with gauze top, and with extra tube for a blast of air to give an intense heat; *h*, a brass cone for collecting a mixture of air and gas; and *i*, *j*, *k*, are three burners adapted to this cone; *i* and *f* having gauze tops, and *k* being provided with a blowpipe: *l* is a pipe coming from the blowing machine, or, in certain cases, from a gasometer containing oxygen gas. When *h* is supplied with coal-gas and air, and *k* *l* with oxygen gas, an intense heat is produced by the jet. *m* is a crucible jacket, which fits the top of the cylinder *g*. The retort stand belongs to the set, and all the pieces fit properly to one another.



938

939. Gas Branch, with collar and thumb-screw, to attach to a retort stand.

1. To fit a Retort Stand the rod of which is $\frac{1}{2}$ inch diameter, 3s.

2. The same with a stopcock to the gas-pipe, 4s. 6d.

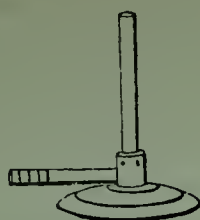
Any kind of vertical burner may be adapted to these branches.

BUNSEN'S GAS BURNERS, which give a blue smokeless flame on burning a mixture of gas and air.

The due performance of Bunsen's burner depends upon the proper admixture of gas and air. If gas is in excess, the flame gives light and smoke, and little heat. If air is in excess, the mixture explodes, and the gas takes fire within the tube, at the bottom. The proper management of such apparatus is explained at article No. 1013.

945. Bunsen's Single Jet, namely, brass tube and iron foot, either plain, Fig. 945, or ornamented, Fig. 949, 1s. 6d.

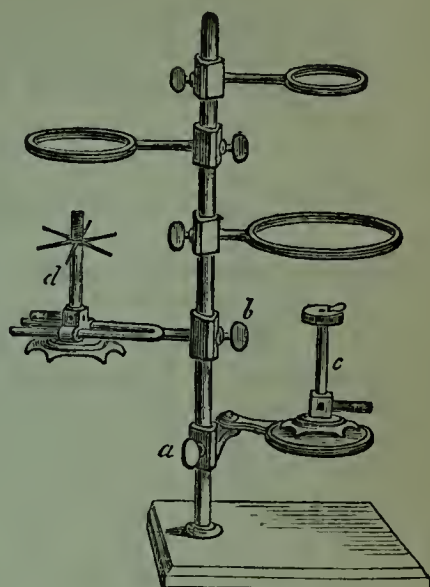
946. Single Jet, with fork holes, by which it can be mounted on a retort stand, as represented by *d*, Fig. 946, 3s.



945.



949.



946.

The other articles shown in Fig. 946 are as follows:—

Iron Retort Stand, with rectangular foot, $9\frac{1}{2}$ by 6 inches, and rod 28 inches by $\frac{5}{8}$ inch; three malleable iron rings, 3, 5, and $6\frac{1}{4}$ inches diameter, with triangular collars and screws, No. 262, 9s. *a*, an Iron Table, No. 273, 3s.; *b*, Iron Fork No. 948, 1s.; *c*, Griffin's Rose Burner, No. 973, 2s. 6d.; *d*, Bunsen's Burner, with star and fork holes, No. 950, 4s.

947. Iron Fork for Bunsen's Burner, with collar to fit a $\frac{1}{2}$ -inch iron rod, and brass thumb-screw, 1s.

948. Ditto, for a $\frac{5}{8}$ -inch iron rod, *b*, Fig. 946, 1s.

949. Single Jet Burner, with Star Support, without fork holes, Fig. 949, 2s. 6d.

950. Ditto with fork holes, *d*, Fig. 946, 4s.

951. Porcelain Plate to put over the Star Support, No. 949, to catch the ashes of a filter when burnt over the blue flame, Fig. 951, 1s. 3d.



951.

952. Iron Tripod Support to hold capsules, &c., over a Bunsen's Gas Burner, 6d.



952.

953. Small Cylindrical Iron Chimney, to put on a star support to steady the flame, 3d.



953.

954. Blowpipe Jet, which acts when dropped into the Bunsen's Jet, &c., so as to cut off the atmospheric air and give a luminous gas flame, 6d.

955. Griffin's Rose Burner, the smallest size, to adapt the Bunsen's Jet for evaporations, *d*, Fig. 975, the head only, 1s.

956. GAS BURNER AND FITTINGS, comprising single jet, with star support, filter plate, blowpipe jet, tripod support, chimney, and rose burner, 6s.

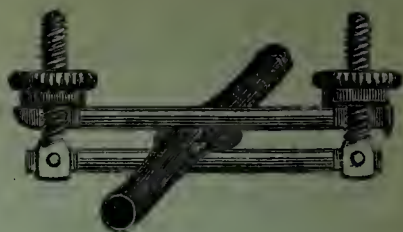
957. The Same Set, when the Burner has fork holes, 7s. 6d.

959. Triple Bunsen's Jet, branching, with fork holes, Fig. 959, without the tripod, 5s.



959.

961. Steatite Gas Burners :—No. 1, Single Bunsen's Jet; 2, Burner with rose head; 3, Ditto, large size.
971. Lever Regulator for a current of gas passing through a caoutchouc tube, Fig. 971, 1s. 6d.
972. The addition of a Stopcock to any gas burner increases the price 1s. 6d.

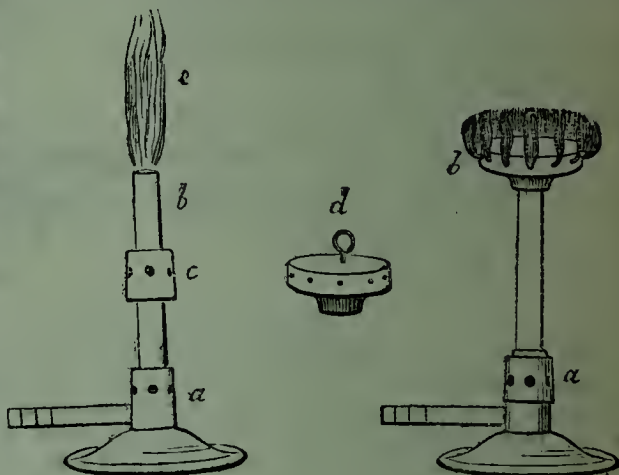


971.

GRIFFIN'S ROSE GAS BURNERS.

The *Rose Gas Burners* give a single flame when crucibles are to be ignited, and a rose or circle of small flames when liquids are to be heated in vessels of glass or porcelain. It is represented by Fig. 975, where *a, b*, is a burner similar to Bunsen's; *c*, a regulator to control the entrance of air into the box *a*, and thus prevent the flame from blowing down; *d*, the rose, which divides and spreads the flame when put on the top of the tube *b*. *e* shows the single or igniting flame; *b*, the spread or evaporating flame.

Three sizes of this burner are made; and to accompany each size, a furnace adapted to secure the most advantageous use of the heat which the burner furnishes. The smallest size of these burners, No. 1, is made without the regulator *c*.



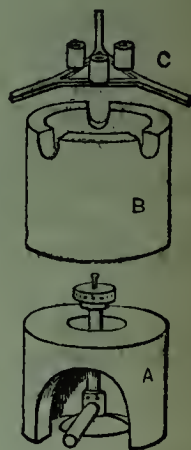
975.

PRICES OF THE ROSE GAS BURNERS SEPARATELY.

973. No. 1, Bore of the single burner, $\frac{3}{8}$ -inch, 2s. 6d.
974. No. 2, ditto, $\frac{5}{8}$ -inch, 5s.
975. No. 3, ditto, $\frac{7}{8}$ -inch, 9s.

FURNACE FITTINGS FOR ROSE BURNER, No. 1.

976. FURNACE FOR EVAPORATION.—Clay furnace, consisting of two pieces, A and B, Fig. 976, which, when put together and the burner supplied with the rose top, produces a convenient furnace for evaporations. The three notches on the upper part of B are intended to receive the branches of a triangular support, such as *c*, Fig. 976, or Nos. 299 to 308. They serve also to keep up the draught when basins, sand-baths, pans, &c., are placed directly upon the furnace. Height 9 inches, diameter 5 inches.



976.

976. Furnace alone, 5s. 6d.
977. Furnace, with No. 1 Burner, 8s.

FURNACE FOR IGNITIONS.

The power of the burner No. 1 is better suited for boiling and evaporating than for crucible operations, and therefore no furnace for ignitions has been provided for it. Nevertheless, for operations that are performed on small quantities of materials in porcelain or platinum crucibles and cups, extemporaneous furnaces can be readily built up with the clay cylinders described at No. 1018.

FURNACE FITTINGS FOR ROSE BURNER No. 2.

981. FURNACE FOR EVAPORATIONS.—Fig. 981 represents a furnace for evaporations. It consists of a fire-clay pan open at the top, and with a hole in the bottom, through which the burner passes, and which admits air to the flame. It is fitted in an iron case, which has three legs to support it, and at the top has three iron pegs to support clay knobs, which keep the evaporating basins from contact with hot iron, and so lessen the chances of fracture. These knobs support basins of all sizes from 6 inches diameter upwards. The heat applied to a metal vessel will boil three gallons of water, and, of course, serve for the evaporation of large quantities. Small basins are to be supported over this furnace by triangles laid across the pan.

981. Price of the Evaporating Furnace, without the burner, 7s.

982. Price of the Furnace, with the Burner No. 2, 12s.

983. FURNACE FOR IGNITIONS.—Fig. 983 represents a furnace suitable for heating crucibles, the Burner No. 2 being used without the rose. It consists of a

furnace body, with a descending flue or tail piece made of fireclay. This is supported in an iron case with three legs. The crucible rests within the furnace on an iron ring of the form shown by *h*, *i*, Fig. 999. The body of the furnace is covered by a small clay cone, and that by an iron chimney 2 feet long. The power of this furnace is sufficient to fuse 1000 grains of anhydrous carbonate of soda, contained in a platinum crucible, in 15 minutes. It will also fuse metallic silver.

983. Price of the Furnace for Ignitions, without the Burner, 8s.

984. Price of the Furnace with the Burner No. 2, 13s.

985. PRICE OF THE COMPLETE FURNACE:—

Burner, 5s.; Evaporating Furnace, 7s.; Crucible Furnace, 8s.; together, 20s.

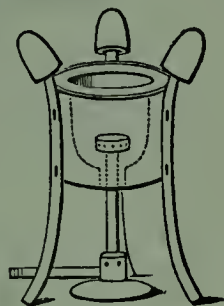
986. CLAY EVAPORATING FURNACE FOR No. 2 BURNER. In two pieces, similar in form to Fig. 976. Height 12 inches, diameter $6\frac{1}{2}$ inches. Price, without the burner, 6s. 6d.

987. The Clay Furnace, with the Burner No. 2. 11s. 6d.

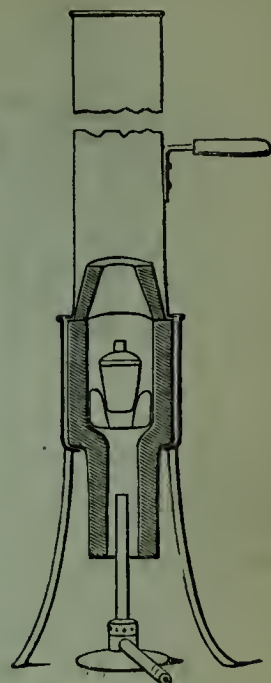
In article No. 1018, it is shown in what manner the lower part of this furnace, A, Fig. 976, can be used as part of a temporary furnace for the ignition of small crucibles.

FITTINGS FOR ROSE BURNER No. 3.

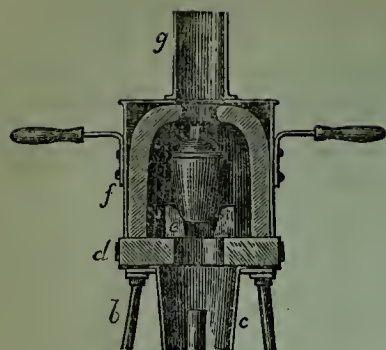
991. The Fittings for the Rose Burner No. 3 are represented by Figs. 993 to 999, with the exception that the evaporating furnace, Fig. 993, in lieu of having flat iron ears to support evaporating basins, is now made with round rods and clay caps, as represented by Fig. 993*a*. The burner, with these fittings, can be used as a convenient source of heat for most operations of the chemical laboratory and lecture table. It will boil a quantity of liquid, exceeding four gallons, at once; it will raise a $4\frac{3}{4}$ -inch fire-clay crucible to full redness; it will fuse anhydrous carbonate of soda in greater quantity than is required for the analysis of a siliceous mineral; and it will melt sterling silver. This amount of power is sufficient for most chemical operations that are not metallurgic.



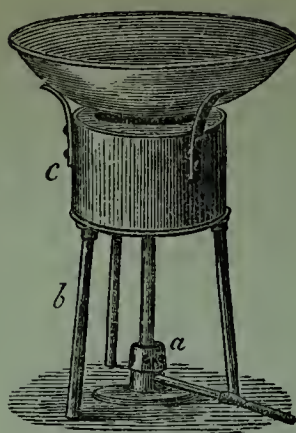
981.



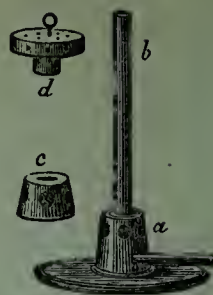
983.



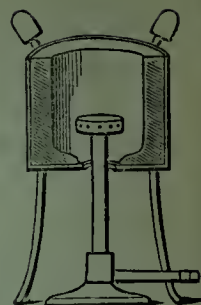
994a.



993.



997.



993a.

PRICE OF THE FITTINGS FOR No. 3 ROSE BURNER.

992. The Furnace complete, comprehending what is represented by Figs. 993, 994, and 995, with the burner 997, 42s.

993. The Furnace for Boiling and Evaporating, Figs. 993 and 993a, with the burner, 21s.

994. The Furnace for Heating large Crucibles (up to $4\frac{3}{4}$ inches high), Fig. 994, with burner and trivet, 25s.

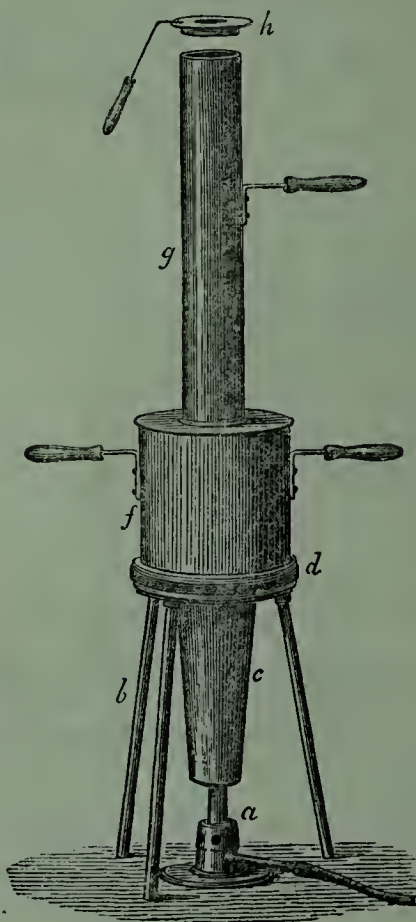
995. The Furnace for Heating small Crucibles, Fig. 995, with the burner and trivet, 21s.

996. One Set of the Fittings, both for large and small Crucibles, represented by Figs. 994 and 995, with one burner, 30s.

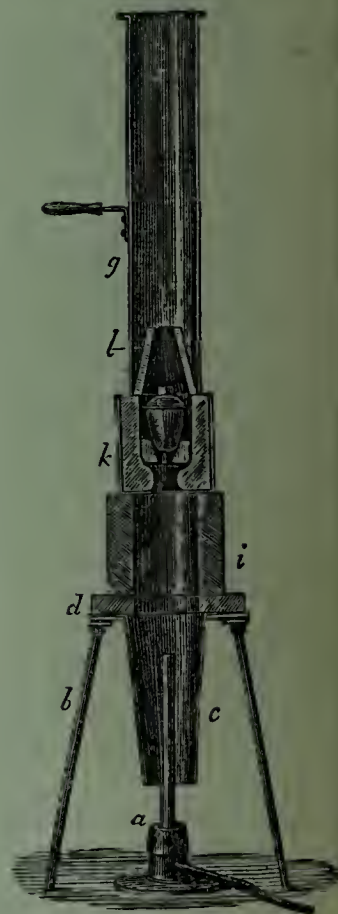
997. The Rose Burner No. 3 alone, 9s.

998. Extra Iron Trivet, Fig. 999, 2-inch, for supporting small crucibles in the furnace, Fig. 995, 6d.

999. Extra Iron Trivet, Fig. 999, 4-inch, for supporting large crucibles in the furnace, Fig. 994, 8d.



994.



995.

1005. *Description.*—Fig 993 represents the evaporating furnace, a section of which is given by Fig. 993 a. When liquids are to be boiled or evaporated in glass or porcelain vessels, the rose burner is to be used; but when a metal vessel is to hold the liquid, the flame from the single jet may be allowed to play on the bottom of the



999.

vessel. Small vessels are to be supported on triangles, No. 299. With this arrangement, and with gas supplied by a $\frac{1}{4}$ -inch pipe, under a pressure which gives about 30 cubic feet of gas per hour, the heat produced, acting upon water contained in a porcelain evaporating basin, will heat from 60° to 212° F. 1 quart in 5 minutes, 1 gallon in 15 minutes, 2 gallons in 30 minutes; and when the water boils it is driven off in steam at the rate of more than a gallon of water per hour. The method is consequently applicable to distillation on a small scale, and to numerous operations in pharmacy.

1006. *Arrangement for Heating to Redness a Large Fire-clay Crucible.*—When a large crucible is to be heated to redness—as, for example, when oxide of copper is to be dried for use in an organic analysis—the gas burner is to be used without the rose, and is to be arranged with the furnace fittings that are represented in perspective by Fig. 994, and in section by Fig. 994*a*, and the lower part of Fig. 995, *a*, *b*, *c*, *d*. Letter *a* represents the gas-burner, Fig. 997; *b* is a tall iron stool; *c*, a chimney which collects atmospheric air to feed the flame, and leads it up close to the vertical tube *b*, by which contrivance the air is warmed and the tube cooled; *d* is a furnace-sole or plate of fire-clay; *f* is a reverberatory dome, the interior of which is best shown in the section, Fig. 994*a*; *e* is a cast-iron ring or trivet, represented more clearly in Fig. 999; *g* is an iron chimney, 24 inches long, and $3\frac{1}{2}$ inches wide; and *h*, a damper, to lessen the draught when small crucibles are to be heated. The height of this apparatus, from *a* to the top of *f*, is 24 inches; and the external diameter of the dome *f* is about 8 inches. The crucible, which may be from $4\frac{1}{2}$ to $4\frac{3}{4}$ inches in height, is placed on the iron ring *e*, Fig. 994 *a*, or Fig. 999, and that on the clay sole *d*, and it is then covered by the dome *f*. The gas should be lighted after the crucible is placed in its position, and before the dome is put on. The dome and the chimney are then to be added, and the operation allowed to proceed. With a crucible of the above size, the damper *h* is not required; but it must be used when the crucible is under 4 inches in height, otherwise the draught, occasioned by extra space within the dome, causes the flame to blow down. The damper must be put on the chimney before the chimney is put on the dome. The iron ring, Fig. 999, or *e*, Fig. 994*a*, suits crucibles of different sizes, according to the side of it which is turned uppermost.

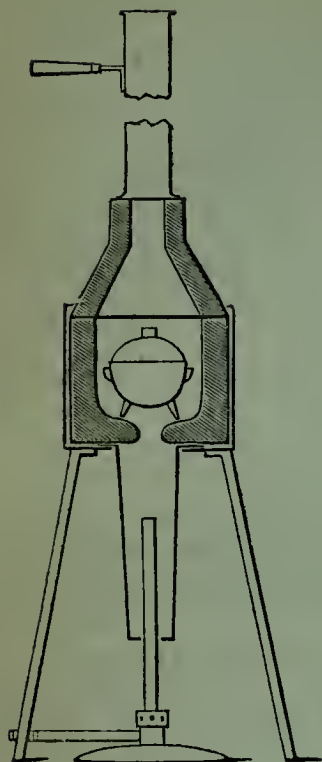
The Figures show that a crucible mounted in this furnace can lose very little heat by radiation or conduction, and hence it is that a small gas flame produces a powerful effect. In half-an-hour, a $4\frac{3}{4}$ -inch clay crucible, filled and covered, can be heated to full redness. The progress of the ignition can be easily examined by lifting up the chimney *g* and the dome *f* by their respective wooden handles. But the action of the furnace can also be judged of by a peculiar roaring noise which it produces. If the gas and air are mixed in due proportions, the roar is regular and continuous. If there is too much gas, the roar is lessened. If too much air, the roar is increased, but is rendered irregular and intermittent. The greater the noise, the greater the heat in the furnace; but when the roar becomes spasmodic, the flame is on the point of blowing down. To prevent that occurrence, the proportion of air must be lessened or that of gas increased.

1007. *Arrangement for Heating Platinum Crucibles, as in the Fusion of Silicates with Anhydrous Carbonate of Soda.*—The following arrangement is convenient when small crucibles are to be strongly heated:—Anhydrous carbonate of soda in quantities exceeding 1000 grains can be thus readily fused in a platinum crucible, and sterling silver can be melted in a clay crucible. It is also available for ignitions or fusions in small porcelain crucibles. Fig. 995 represents the arrangement of apparatus as seen in section. *a* is the gas-burner; *b*, the stool; *c*, the air-chimney; and *d*, the furnace sole, as already explained. *i* is a cylinder of fire-clay, 4 inches high, and $4\frac{1}{2}$ inches diameter; *k* is a fire-clay furnace, in which is placed a small cast iron ring, about 2 inches in diameter, similar in form to that represented by Fig. 999, and on this ring the platinum crucible is adjusted; *l* is a fire-clay or plumbago reverberatory dome; and *g* is the chimney that forms part of the furnace represented by Fig. 994. The crucible being adjusted, the gas lighted, and the dome and chimney put on, the lapse of 12 or 15 minutes, according to the quality and pressure of the gas, suffices for the fusion of 1000 grains of carbonate of soda in a platinum crucible. At the heat which this furnace produces the cast-iron ring does not melt, nor alloy with the platinum crucible placed upon it.

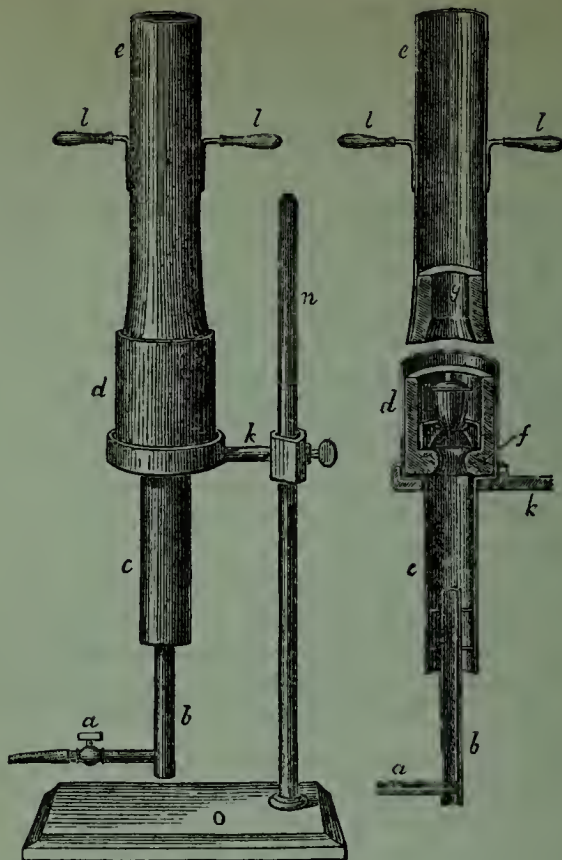
1008. GAS MELTING FURNACE, FOR QUANTITIES OF LEAD, ZINC, ANTIMONY, &c., with Gas-Burner and Iron Crucible, complete, as represented by Fig. 1008, 30s.

The iron crucible will contain nearly 30 lb. of lead, and about 24 lb. of zinc. The burner readily melts these quantities, and then, with a diminished quantity of gas, will keep the metals fluid. The metals being protected from the air, suffer little loss by oxidation. Such operations as the granulation of zinc are performed with this apparatus with great facility. It serves also for baths of fused metal. In a larger furnace of this kind, made for a special operation, I have with the burner No. 3 melted 60 lb. of zinc with ease; and I believe that, used in this manner, the burner is powerful enough to melt a hundredweight of zinc.

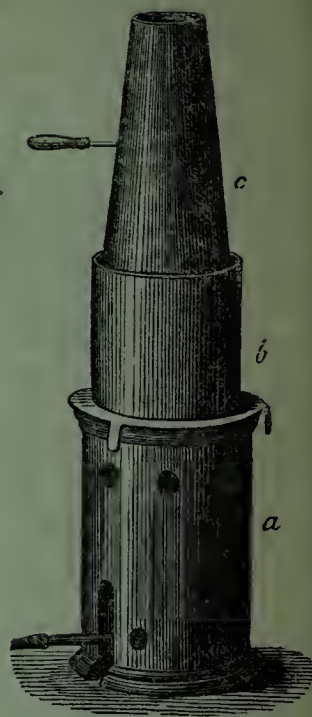
1009. Gas Crucible Furnace, suitable for analytical operations with platinum crucibles. Figures 1009 show it in perspective and in section. The power is sufficient to fuse 1000 grains of anhydrous carbonate of soda in ten minutes.



1008.



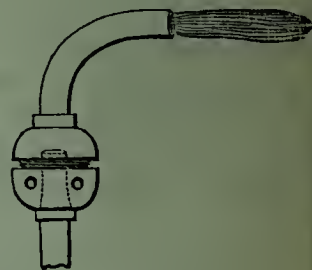
1009.



1010.

- It will take in a crucible measuring nearly $2\frac{1}{2}$ by $2\frac{1}{2}$ inches. Price of the Furnace, complete, with support but without stopcock, 14s.; price with the stopcock, 15s. 6d.
1010. Gas Crucible Furnace, consisting of a saltglazed stoneware Cylinder, 8 inches high; a Bunsen's Burner, similar to No. 2, but without the rose-head; a Crucible Furnace, body and trivet similar to *k*, Fig. 995; an iron top to support the crucible furnace on the cylinder, and a chimney; the whole resembling Fig. 1010. 12s. 6d.
1011. Gas Burner, for burning a mixture of gas and air, to heat flues, for boiling water in fixed coppers, &c.; stout iron pipe, 1-inch bore, with regulator for the atmospheric air. Fig. 1011, 7s 6d.

1012. *The Principles of Heating by Gas*, which have led to the construction of these gas furnaces, may be summed up as follows:—When a crucible or other solid body is to be heated, it is to be wrapped in a single flame at the point of maximum heat, and loss of heat by radiation and conduction is to be prevented by the interposition of non-conducting materials (plumbago or fire-clay); and when liquids are to be boiled or evaporated, particularly when they are contained in vessels of glass or porcelain, the flame is to be broken up into numerous horizontal jets, and these are to be made to supply a large and regular current of highly-heated air, by which alone, and not by the direct application of the flame, the vessel that contains the liquid is to be heated. In both cases provision must be made to secure a sufficient draught of air through the furnace, because every cubic foot of gas requires for combustion 10 or 12 cubic feet of air, and the gases which have done their duty must be rapidly carried away from the focus of heat. If the steam, the carbonic acid gas, and the free nitrogen, which constitute the used-up gases, are not promptly expelled, fresh gaseous mixture, in the act of producing additional heat by combustion, cannot get near the object that is to be heated, and the heat so produced out of place is wasted.



1011.

1013. *Remedy for the common Defects of Bunsen's Burner*.—Bunsen's gas-burner, whatever its size, is subject to two defects: sometimes the flame burns white and smoky, and sometimes it blows

down, the gaseous mixture explodes, and the gas then burns with a smoky flame in the tube. The remedies for these defects are as follows :—If the flame is white only when the gas is turned on very full, the remedy is to lessen the supply of gas ; but if the flame continues to burn white at the top when the gas is gradually turned off, and the mass of flame slowly sinks, then the holes which deliver the gas from the supply pipe into the air-box *a*, Fig. 997, are too large, and are placed too directly under the centre of the vertical tube *b*, Fig. 997, and these defects must be corrected in the instrument. Finally, when the flame blows down, it is because the supply of atmospheric air is too large in proportion to the supply of gas, and their relative proportions must be altered. To effect this alteration, the cap *c* is to be turned round on the air-box *a*, so as partially to close the holes, and thus lessen the supply of air. If, when the gas is alight, the flame needs to be lowered, first the supply of air is to be lessened, and then the supply of gas. If the flame is to be enlarged, first the supply of gas must be increased, and then the supply of air. In short, to prevent the flame blowing down, the gas must always be first placed in excess, and then have the proper quantity of air adjusted to suit it by means of the regulator *c*. When gas-burners of this description have to be used in a locality where the pressure of the gas is slight, especially in the daytime, there is a constant tendency in the flame to blow down. The best way to prevent that occurrence is to supply the gas by a pretty wide tube, and to see that the current of gas is not checked by a very narrow bore in the plug of an intervening stopcock, which I have frequently observed to be the unsuspected cause of want of pressure in the supply of gas. If this does not suffice to prevent the blowing down of the gas, the holes which admit the gas from the supply pipe into the box *a* of the burner should be enlarged, more or less according to necessity. A large supply of gas compensates, to some extent, for want of pressure.

When a steady and long-continued heat is desired from a Bunsen's burner, it is proper to use two stopcocks and a length of caoutchouc tube between them. One of these stopcocks is to be affixed to the burner, and the other to the supply pipe. The latter is to be opened *wider* than is necessary to supply the required quantity of gas, and the former is to be used to regulate the supply to the burner exactly. Under these circumstances, if another stopcock is opened and gas burnt in the immediate neighbourhood, the flame does not so readily blow down in the regulated burner as it does when only the stopcock on the supply pipe is used.

EXTEMPORANEOUS CRUCIBLE FURNACES, WHICH CAN BE BUILT UP OF FIRECLAY CYLINDERS TO FIT CRUCIBLES OF ANY GIVEN SIZE.

1018. When a crucible is suspended by wires or by a ring over the flame of a spirit lamp or gas burner, the flame and the hot air supplied by the flame strike the crucible for an instant, and then pass away to do no more good. At the same time, the effect of the heating power on the crucible is lessened by other circumstances ; namely, by radiation on all sides, by a mass of cold air which constantly rises around and in contact with it, and by the conducting power of the metallic apparatus which supports both the crucible and the lamp. These losses are avoided if the crucible is enclosed in a furnace made of a non-conducting material, such as fire-clay, which can absorb and retain heat. I have shown in the descriptions of the gas furnaces, and in that of Charles Griffin's Oil-Lamp Furnace, several methods of mounting crucibles in fire-clay jackets, and I have now to describe some furnace fittings that may be used to construct temporary table furnaces for crucibles that are to be exposed to the flame produced by gas, oil, or spirits, up to a temperature close upon, but not quite up to, a white heat ; that is to say, up to a heat that will readily melt anhydrous carbonate of soda and small quantities of silver, and so be fit for most analytical operations ; but which will not melt copper nor cast-iron, and therefore not be fit for metallurgic operations, the heat for which, generally speaking, requires for its production either the aid of a very tall chimney or a blowing-machine, and necessarily the aid of furnaces and fittings suitable to sustain the required high temperature. There is no economy in making the same gas furnace serve for operations both at a red heat and a white heat.

Figures 1024 to 1050 represent sections of cylinders of fireclay, which are drawn on a scale of 1 inch to 8 inches, and have the relative heights and bores represented in the figures. The clay pieces, that is to say, as many of them as are necessary for a given purpose, can be adjusted over a gas flame by means of a tripod, Fig. 959 or 994, or a ring such as *k*, Fig. 1009, or a clay support such as *A*, Fig. 976.

1019. GRATES.—The crucible to be operated upon is to be supported on a toothed ring, made either of cast-iron or fire-clay, such as are represented by Figs. 999 and 1019. Fig. 999 is a ring of cast-iron, *h* representing it in section, and *i* as seen from above. It is about 2 inches in diameter, and has three teeth projecting towards the middle of the ring. This ring can be supported by any of the clay cylinders whose bore does not exceed 2 inches. Fig. 1019 is a ring of fire-clay of 4 inches external diameter and 1 inch in thickness, provided with three teeth that project inwards, and upon which a crucible can be supported without injuring the draught of the gas furnace. Both these



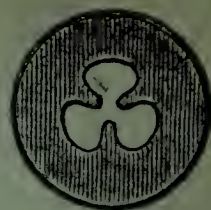
grates will support crucibles at the highest temperature which can be produced by spirit, oil, or gas, without a blast of air; but at a white heat produced by any of these fuels with a blast of air, the iron ring melts, and if the heat is long continued, those of fire-clay soften and partially give way. When the fire-clay grate, Fig. 1019, is required to sustain a very high temperature for a considerable time, it is proper to have it made of 6 inches diameter, as represented by Fig. 1042, the air-way in which is the same as that of the small grate, but the clay ring is much stronger.

1020. *Action*.—The grate is fixed above the flame at a distance which is found by trial to place the crucible in the point of greatest heat. Commonly, a 4-inch cylinder, No. 1027 or No. 1034, placed upon a suitable support, serves the purpose. The bore of the cylinders at the bottom must be wider than the burner, to allow of a considerable influx of atmospheric air around the flame. The grate is placed on this cylinder, the crucible on the grate, and then another cylinder around the crucible. The choice of this upper cylinder depends entirely upon the size of the crucible that is to be heated. Whatever the size of the crucible, the cylinder must be so chosen as to fit the crucible as accurately as possible, leaving between it and the furnace walls an open space of not less than $\frac{1}{8}$ inch, nor more than $\frac{1}{2}$ inch, all round. If the upper cylinder is not contracted at top, like Nos. 1032, 1033, 1034, then a cylinder of narrow bore, such as Nos. 1024, or 1025, must be put upon it, in order to deflect the flame and the rising current of hot air upon the top of the crucible, and thus produce a reverberatory furnace. Finally, an iron chimney, 2 or 3 feet long, must be put upon the furnace, to force up a draught of air sufficient to feed the flame.

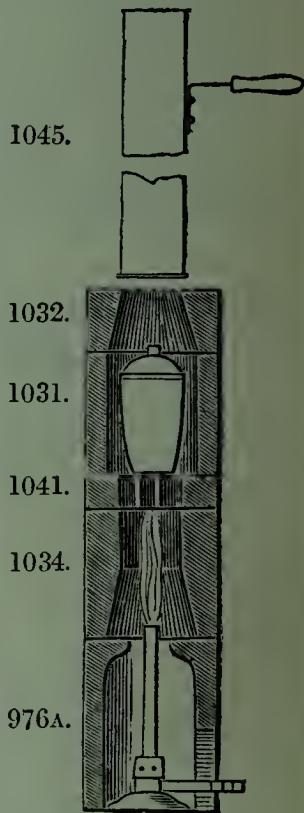
1021. *Example*.—Suppose the Rose Gas Burner No. 2 is to be arranged for an ignition, with the use of the fire-clay support, A, Fig. 976. The combination of pieces necessary for the purpose may be those represented by Fig. 1021, where A is the fire-clay support, No. 976; and the rest of the pieces are those which are figured and described at the numbers placed against each of them in this figure. It is evident that the application of this furnace to crucibles of different sizes depends upon the proper choice of the cylinders, here marked 1031 and 1032. Of course there is only a limited choice of crucibles suitable for such operations. Three inches is the extreme width between the furnace walls of any of the pieces from No. 1024 to No. 1034; and though larger cylinders could be used, such as those from No. 1035 to No. 1040, it must be remembered that the flame of a lamp without blast has only a limited power, and that although a given flame will fuse 1000 grains of carbonate of soda in a platinum crucible, it may only heat to a moderate redness a large clay crucible. Yet, considering that low degrees of heat are suitable for many chemical purposes, it is convenient to have the power of readily adjusting a temporary furnace to the bulk of any crucible which it is desired to heat.

1022. The clay pieces Nos. 1035 to 1042 are those that have been expressly designed for the blast oil furnace described at No. 912; but these can also be used for spirit and gas furnaces, the respective sizes being chosen in each case according to the size of the crucible that is to be ignited. In respect to the *means of supporting* a crucible, it has been shown in the description of No. 912, that clay trivets with a wide flange, namely, the 6-inch trivets No. 1042, will support a crucible containing 5 lb. of iron until that quantity of iron is melted, even under the operations of a blast: so that it is evident that this method of supporting a crucible in a gas flame may be always depended upon when no blowing-machine is employed.

But the discovery of the fact, that a trivet of fireclay of the form of Fig. 1019, could sustain a crucible bearing 5lb. of cast iron, until that quantity of iron was melted under the action of a blast, induced me to make some experiments on the joint use of a small blast gas burner and the small fireclay cylinders that are described in this section, and these experiments have led to the construction of the MINATURE BLAST GAS FURNACE, described in No. 1155, an apparatus that justifies the recommendation that I have given of the use of these cylinders; for in the Miniature Blast Gas Furnace, the chemist has an instrument which possesses great power, in a small compass, and convenient form, the cost of which is a trifle, and which, by the addition or exchange of a few fireclay cylinders, can be modified to suit a great variety of operations at high temperatures.



1019.



1021.

1023. PRICES OF FIRECLAY FURNACE CYLINDERS, all bound with Iron.

A.—PLAIN CYLINDERS.

No.	Outside Diameter.	Height.	Bore.	Thickness of Walls.	Price.
1024	4 inch.	1 inch.	2 inch.	1 inch.	1s.
1025.	4 inch.	1½ inch.	2 inch.	1 inch.	1s.
1026.	4 inch.	3 inch.	2 inch.	1 inch.	1s. 3d.
1027.	4 inch.	4 inch.	2 inch.	1 inch.	1s. 6d.
1028.	4 inch.	1 inch.	3 inch.	½ inch.	1s.
1029.	4 inch.	1½ inch.	3 inch.	½ inch.	1s.
1030.	4 inch.	3 inch.	3 inch.	½ inch.	1s. 6d.
1031.	4 inch.	4 inch.	3 inch.	½ inch.	1s. 6d.

B.—CYLINDERS WITH CONICAL BORE.

No.	Outside Diameter.	Height.	Bore. Wide end.	Bore. Narrow end.	Price.
1032.	4 inch.	2 inch.	3 inch.	2 inch.	1s. 4d.
1033.	4 inch.	4 inch.	3 inch.	2 inch.	1s. 6d.
1034.	4 inch.	4 inch.	3 inch.	2 inch.	1s. 6d.

C.—CYLINDERS OF THE OIL FURNACE, No. 912.

No.	Outside Diameter.	Height.	Bore.	Thickness of Wall.	Price.
1035.	5 inch.	4 inch.	3 inch.	1 inch.	1s. 9d.
1036.	6 inch.	5 inch.	4 inch.	1 inch.	2s.
1037.	6 inch.	1 inch.	2 inch.	2 inch.	1s.
1038.	8 inch.	6 inch.	5 inch.	1½ inch.	3s.
1039.	8 inch.	2 inch.	2 inch.	3 inch.	1s. 6d.

1040. Flanged Cylinder, 6 inches across the flange, 2 inches bore, 6 inches high, 4 inches across the funnel shaped mouth, 2s.

1041. Fireclay Grate, small size, outside diameter, 4 inches, Figs. 1019 and 1042, 1s. 3d.

1042. Fireclay Grate, large size, outside diameter, 6 inches, Figs. 1019 and 1042, 1s. 6d.

1043. Iron Grate, Figure 999, 2 inches diameter, 6d.

1044. Iron Grate, Figure 999, 4 inches diameter, 8d.

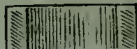
1045. Iron Chimney, with handle, but not lined with fireclay, 2 feet long, 2s. 6d.

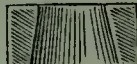
1046. Ditto, 3 feet long, 3s.

1024. 

1028. 

1025. 

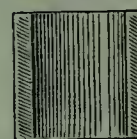
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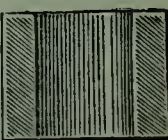
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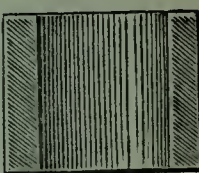
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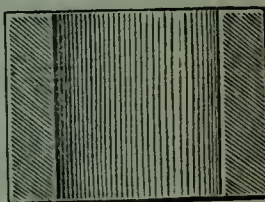
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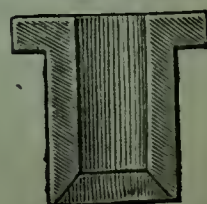
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D. CYLINDERS OF THE MINIATURE BLAST GAS FURNACE, No. 1155.

1047. Cylinder, 4 inches diameter, $1\frac{1}{2}$ inch thick, $1\frac{1}{4}$ inch bore, 1s.1048. Cylinder, 6 inches diameter, $1\frac{1}{2}$ inch thick, $1\frac{1}{4}$ inch bore, 1s. 6d.

1049. Cylinder, 6 inches diameter, 2 inches thick, bore 3 inches at the wide end, 2 inches at the narrow end, 2s. 6d.

1050. Cover on three feet, *m*, Fig. 912, and 1050 in Fig. 1155, 4d.

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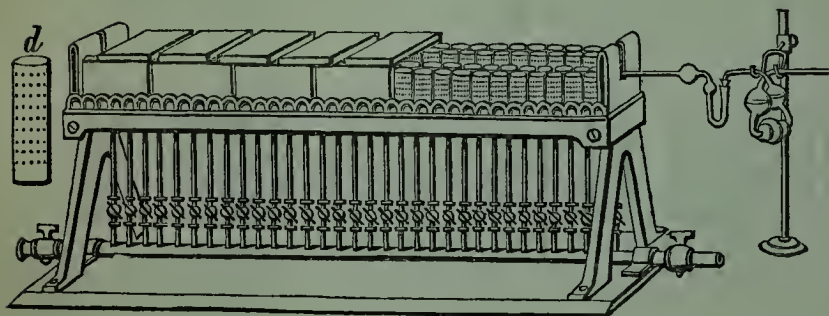
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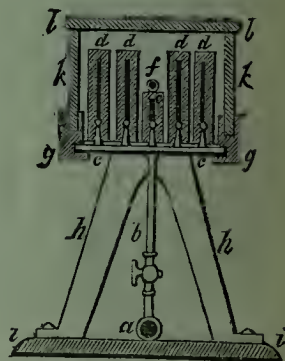
Gas Furnaces for Heating Tubes.

HOFMANN'S GAS COMBUSTION FURNACE.

1051. In this apparatus the combustion of the gas, supplied by a series of vertical gas jets, is effected by means of a number of perforated clay burners, in which the gas is mixed with air. These burners are so grouped as to form a channel for the combustion tube, a system of stopcocks serving to regulate the heat, or to confine it within any desired limits. A full description of the apparatus by Professor Hofmann will be found in the "Quarterly Journal of the Chemical Society," vol. xi., page 30.



1051.



1052.

1052. This furnace is made of various sizes, to suit long or short combustion tubes, with 3 or 5 rows of burners, and with one or two parallel channels. Fig. 1051 is a perspective view of this Gas Furnace, with five rows of burners arranged for one tube, and Fig. 1052, a section made crosswise, to show the arrangements of the several parts. The clay burners are of two sizes,—*short* ones, whose ends support the combustion tubes, and *long* ones, which rise up and supply flames on each side of the combustion tube. The form of the burners is shown at letter *d*, Fig. 1051. When there are three rows of burners, they are arranged thus: *l s l*, where *l* signifies a long burner, and *s* a short one, the combustion tube lying upon *s*. With five rows of burners, the arrangement for *one* combustion tube is this: *l l s l l*, as shown in the Figures; and for *two* combustion tubes it is *l s l s l*. The furnace is supplied with a stopcock at each end of the main gas pipe.

Description of Fig. 1052.—*a* is the main gas-pipe; *b* is one of the vertical gas-pipes, with its stopcock; *c c*, a cross pipe armed with jets to throw the gas into the clay burners; *d d d d*, the long clay gas-burners; *f*, the short burners upon which the combustion tube rests; *g g*, iron side-frames,

to fix the apparatus together; *h*, iron framework, to support the furnace; *ii*, iron vase; *kk*, side-plates of fire-clay, to prevent loss of heat from the burners by radiation; *ll*, flat plates of fire-clay laid on the top, to prevent loss of heat by too free radiation upwards; which plates, however, are not to be set so close together as to injure the draught.

LIST OF PRICES OF HOFMANN'S FURNACES.

No.	Length of Combustion Tube, for which the Furnace is used.	Number of Stopcocks.	Rows of Burners.	Total Number of Burners.	Price.
1053	34-inch tube.	34 stopcocks.	5 rows.	170 burners.	£7 7s.
1054	26-inch tube.	26 stopcocks.	3 rows.	78 burners.	£5 5s.
1055	10-inch tube.	10 stopcocks.	3 rows.	30 burners.	£3.

1060. Clay Burners, short or long, per dozen, 2s.

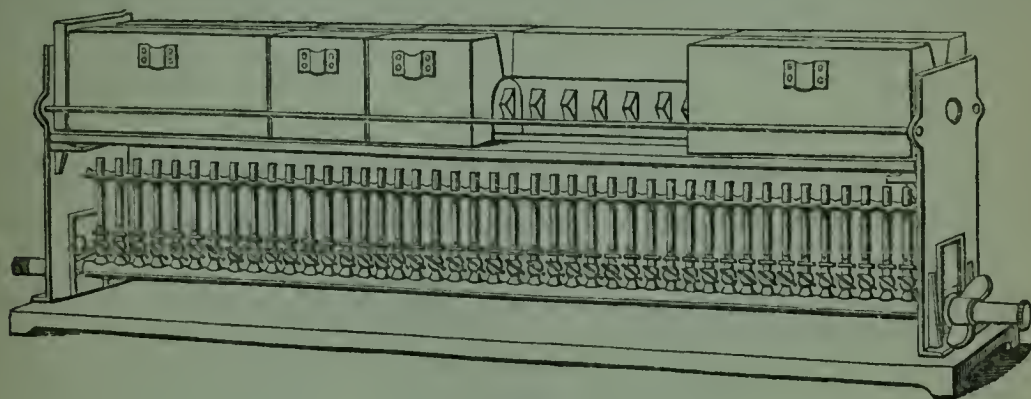
1061. Flat Clay Plates, per dozen, 2s.

1062. Hofmann's Gas Combustion Furnace, for use when oxygen gas is required to effect the complete combustion of some organic substances, as described in the *Quarterly Journal of the Chemical Society*, vol. vi., p. 209, and in Liebig's *Handbook of Organic Analysis*. Price £3 10s.

1063. Pair of Gas Holders to contain oxygen gas, for use with this furnace. Copper, £6.

GRIFFIN'S GAS FURNACE FOR HEATING TUBES, AND FOR COMBUSTIONS IN ORGANIC ANALYSES.

1064. This apparatus is represented by Fig. 1064. It consists of a series of Bunsen's gas burners, arranged in a line so close together as to give almost a continuous blue flame. Above this flame is placed a double row of fire-bricks, so formed as to make a longitudinal reverberatory furnace, in which a tube of any material—glass, porcelain, iron, or platinum,—can be easily heated to redness, and kept at a red heat. The different parts of this furnace are firmly connected together by a substantial iron framework. The bricks are supported by two stout flat iron plates, which pass from end to end of the furnace, and are screwed to the upright supports. At the back of each row of bricks there is an iron rod to keep the bricks from falling outwards.



1064.

The furnace is made of several sizes, as specified in the following list, where the *length* signifies the clear space between the end tiles of the furnace, or the length of tube that would be exposed to the direct action of the flame.

1065. Inside length, 30 inches, 43 burners, price £6 6s.

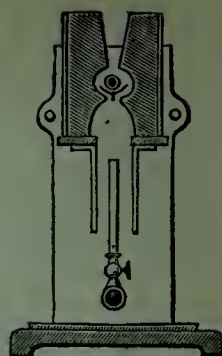
1066. " 23 " 33 " " £5 5s.

1067. " 15 " 22 " " £4 4s.

1068. " 12½ " 16 " " £3 3s.

1071. Description.—The horizontal main pipe can have gas applied at either end, or at both; there is a screw cap to close one end when not required, which is usually the case, as a supply of gas at one end is sufficient at ordinary pressure to give a flame that will fuse the most refractory glass that can be procured. The form of the bricks used for the furnace is shown in perspective in Fig. 1064, and in cross section by the upper shaded part of Fig. 1071. The draught of the furnace is regulated by the distance at which these bricks are placed from one another. Each brick is cased in iron, and has an eye at the back, by which, and the hook, Fig. 1073, it can be readily adjusted in place. Fig. 1072 represents a clamp for turning the stopcocks of the gas-burners, which are set too close together to be conveniently moved by the fingers.

Support of Tubes in the Furnace.—Metallic or porcelain tubes, that are not subject to bend when hot, are supported in this furnace by the end supports of the furnace, which are provided with holes at the level of the teeth of the bricks (compare Figs. 1064 and 1071). Short lengths of tube can be supported on the teeth of the bricks. But glass tubes, such as are used in organic combustions, fuse too readily in the heat of this furnace, and require a support. This may consist of a series of upright slips of stout sheet iron, such as are used in Liebig's original combustion furnace, for use with charcoal; or it may consist of an iron tray with a keel, such as represented by Fig. 1074. A cross section of this tray is shown at the right-hand end of Fig. 1074, and also *in situ* in Fig. 1071. The keel prevents the warping of the tray.



1071.



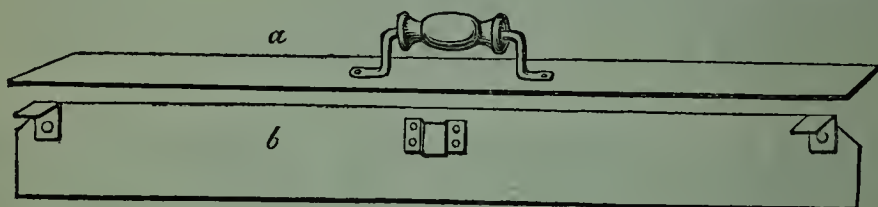
1072.



1073.



1074.



1075.



1077.

1075. Regulation of the Heat.—1. By attention to the main supply pipe, of course, more or less gas can be given to the whole series of burners. 2. Each burner being provided with a stopcock, can be individually regulated. 3. The regulation of the space between the bricks is another means of changing the degree of heat. 4. When the bricks become red-hot; a great quantity of heat is radiated downwards, which is not only a loss, but one that acts injuriously on the row of burners. To prevent this action, two iron plates of the form represented by *b*, Fig. 1075, are fixed, one on each side of the furnace, as shown in Fig. 1071, the supports for the plates being represented at the two ends in the front of Fig. 1064. Those plates force the current of air that is required to feed the flames to pass close by the burners, and keep them cool. With these plates a given heat is produced by a smaller quantity of gas than is necessary without them. 5. Finally, the entire row of burners can be raised 3 inches nearer to the tube when a strong heat is required, by merely loosening the thumb-screws at the two ends of the furnace, lifting up the main gas tube with the burners, and again fixing the thumb-screws. The following experiment shows the importance of this movement:—

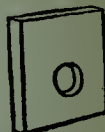
Trial with a Furnace (No. 1066) with 33 Jets.—Gas supply pipe, $\frac{1}{2}$ -inch bore. Object, to keep a cast-iron pipe of an inch diameter continuously at the same apparent degree of red heat.

1. The top of the gas burners being 3 inches from the iron pipe, and the pressure of the gas $\frac{4}{10}$ -inch of water, the consumption of gas was 12 cubic feet in 15 minutes.

2. The top of the gas-burners being 1 inch from the iron pipe, and the pressure of the gas reduced to $\frac{2}{10}$ inch of water, the consumption of gas was 6 cubic feet in 15 minutes.

That is to say,—to keep up the same degree of heat, twice as much gas was necessary in the one case as in the other. Thus, while this arrangement gives the power of raising the heat when necessary, it at the same time enables the operator to practise economy in the consumption of gas.

1076. Fig. 1076 represents a clay plate put at each end of the furnace, when it is employed for combustions, to keep the heat from passing from the body of the furnace outwards to the corks, &c., which it may be desirable to keep cool. One of these plates is shown *in situ* at the left-hand end of the furnace, Fig. 1064.



1076.

1077. When an operation with this combustion furnace has ceased, the top of it may be closed by the iron cover, *a*, Fig. 1075, which prevents the passage of air through the furnace, and also prevents

the descent of dust into the gas-burners. The latter, however, are best protected by an iron cover of the form of Fig. 1077, which should be put over the jets as soon as an operation is ended, and the gas turned off, because dust, bits of glass, or any kind of rubbish that falls into the tubes, causes the gas to burn with white light, instead of the proper blue flame.

GRIFFIN'S GAS COMBUSTION FURNACE.

1078. This furnace differs from the preceding (No. 1064), chiefly in the form of the Firebricks that constitute the upper portion, and in the manner of supporting the Combustion Tube within it.

The following five sizes are made:—

1079.	Inside length,	30 inches,	42 burners,	price	£6 6s.
1080.	"	25 "	36 "	"	£5 5s.
1081.	"	21 "	30 "	"	£4 10s.
1082.	"	17 "	24 "	"	£3 15s.
1083.	"	13 "	18 "	"	£3 3s.

1086. *Description.*—The lower part of this furnace is represented by Figure 1064, from the iron plates which support the bricks downwards. But the bricks above described (No. 1071) being removed, the upper part of the furnace is built up as follows:—

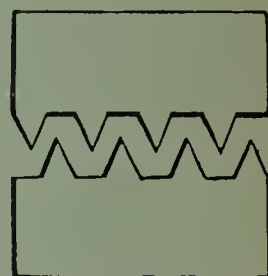
1087. Upon the two iron plates above the gas flame are placed two rows of fire bricks with zigzag edges, each brick being 4 inches long, 2 inches wide, and $\frac{1}{2}$ inch thick; these rows extending the whole length of the furnace. The form of the bricks is represented in Fig. 1087. The toothed or vandyked edges of these bricks can be put at any desired distance from each other, and the bricks therefore permit more or less draught through the furnace. The points of the zigzags form the furnace-grate, upon which the glass combustion tube lies solidly and evenly.

1088. Upon this zigzag grate another tier of fire-bricks is placed, of the form shown by Fig. 1088. These bricks are 4 inches long, 2 inches wide, and 1 inch thick. The combustion tube is placed between them, as represented in the figure, and the flame rises through the zigzags on each side of the tube. The bricks in general require to be pushed close to the tube, but they can be withdrawn to any distance which the due regulation of the draught and heat may require.

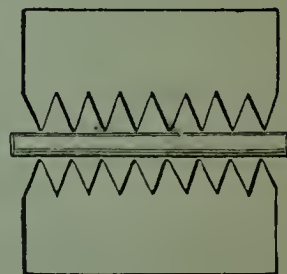
1089. Finally, a third tier of bricks, similar to those that constitute the grate, is put on the top, and these bricks are pushed to a certain degree of closeness to form a sort of reverberatory dome, which makes the gas flame bend upon and heat the upper surface of the glass tube, before it leaves the furnace.

1090. Figure 1090 represents a cross section of these bricks as arranged in connexion with a combustion tube; *a* is the combustion tube; *b*, *b*, the flat bricks of the form of Fig. 1087, pushed pretty close together to form a grate for the support of the tube; *c*, *c*, are bricks of the form of Fig. 1088, constituting the side walls of the furnace; and *d*, *d*, are flat bricks similar in form to those of the grate, but constituting as here placed the dome of the longitudinal furnace. At each end of the furnace a perforated clay plate, similar to Fig. 1076, is placed to cut off the heat from the iron end plate of the furnace. Of course, after the gas has been lighted a little while, all the points of these zigzags acquire a bright red heat, so that the glass tube is exposed on all sides either to a blue gas flame or to contact with red-hot fireclay. The method of regulating and diminishing the heat has been described in the account of the preceding tube furnace; but it may here be added, that if *additional* heat is required, it may be produced by putting on the top of the furnace two rows of bricks or two plates of iron facing each other.

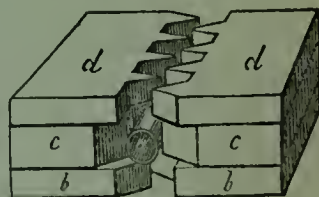
The top of this furnace is four inches lower than the furnace No. 1064. It can be made seven inches lower if the power of moving the series of gas burners up and down in a body is dispensed with. In that case, also, the cost of a furnace would be reduced 10s.; but then the advantages attending this movement, as described in paragraph 1075, would be lost, and that power is sometimes valuable in consequence of the irregular pressure at which gas is often supplied from public works.



1087.



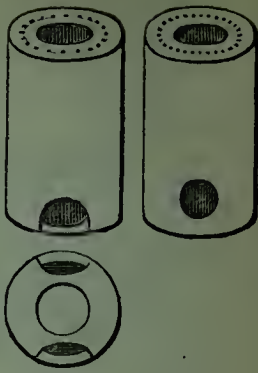
1088.



1090.

ARGAND GAS BURNERS, MADE OF WHITE GLAZED BERLIN PORCELAIN.

1091. These Gas Burners are very neatly made, are not acted upon by the heat, nor corroded by the impurities which accompany coal gas. They are easily kept clean, and have an elegant appearance. They serve either for use with gas for purpose of illumination, or to mix gas with air for thermogenic use. There are two forms, Figs. 1091 and 1092. The latter has one hole to admit the gas, and is used for branches. The former has two holes to suit the forks of an upright argand burner.



All sizes at the same price, SIXPENCE each.

1091. 1092.

1092. For Branch Pipes. Burner, 1 $\frac{3}{4}$ inch high.			1091. For Upright Pipes. Burner, 1 $\frac{3}{4}$ inch high.			1091. For Upright Pipes. Burner, 1 $\frac{1}{4}$ inch high.		
No.	Diameter.	Holes.	No.	Diameter.	Holes.	No.	Diameter.	Holes.
1.	$\frac{7}{8}$ inch	32	1.	$\frac{7}{8}$ inch	32	7.	$\frac{7}{8}$ inch	32
1.	$\frac{7}{8}$ inch	40	1.	$\frac{7}{8}$ inch	40	7.	$\frac{7}{8}$ inch	40
2.	$\frac{1}{16}$ inch	16	2.	$\frac{1}{16}$ inch	16	8.	$\frac{1}{16}$ inch	16
2.	$\frac{1}{16}$ inch	18	2.	$\frac{1}{16}$ inch	18	8.	$\frac{1}{16}$ inch	24
3.	$\frac{1}{16}$ inch	24	3.	$\frac{1}{16}$ inch	24			
4.	1 inch	40	4.	1 inch	40			

GRIFFIN'S BLAST GAS FURNACE.

1100. This furnace is suitable for the fusion of refractory metals, and for all purposes of ignition, combustion, fusion, or dry distillation at a red heat, or a white heat : where it is desirable to produce those temperatures and effects promptly, certainly, steadily, conveniently, and cheaply.

THE BLAST GAS FURNACE consists of two parts, namely, of a particular form of Gas-burner, which is supplied with gas at the usual pressure, and with a blast of common air, supplied by bellows or a blowing machine, at about ten times the pressure at which the gas is supplied.

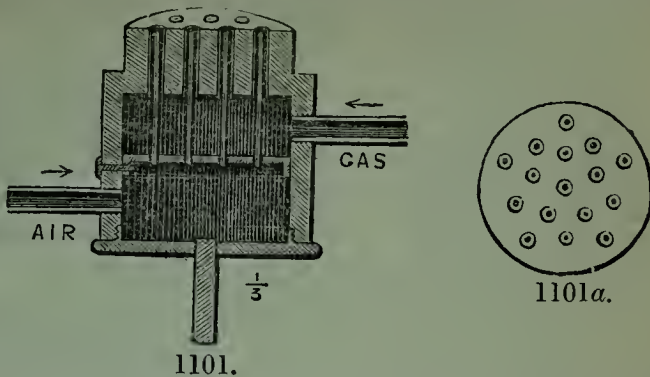
Secondly, of a Furnace, which is built up round the flame that is produced by the gas-burner, and the crucible that is exposed to ignition. The object of the peculiar construction of this furnace is to accumulate and concentrate in a focus the heat produced by the gas flame, and to make it expend its entire power upon any object placed in that focus.



1100.

This apparatus is made of various sizes, according to the amount of work which is required from it.

1101. THE GAS-BURNER is a cylindrical iron reservoir, constructed as shown in section in Fig. 1101, which is drawn on a scale of one-third the full size. It contains two chambers, which are not in communication with one another. Into the upper chamber, gas at ordinary pressure is allowed to pass by the tube marked GAS. Into the lower chamber, air is forced by the tube marked AIR. The upper part of the burner is an inch thick in the metal. Through this solid roof holes are bored for the escape of the gas. The experiments described hereafter were chiefly made with a burner that contained sixteen holes, arranged as shown in Fig. 1101a, which is a surface view of the burner represented by Fig. 1101. But burners, with three holes, six holes, and twenty-six holes, have been made for other purposes. The number of holes depends, of course, upon the heating power required from the burners.



1101.

The air passes from the lower chamber, through a series of metal tubes placed in the centre of the gas-holes, and continued to the surface of the burner, so that the gas and air do not mix until both have left the gas-burner, and then a current of air is blown through the middle of each jet of gas. The bottom of the gas-burner is made to unscrew, and the division between the two chambers, which carries the air-tubes, is easily removable, for the purpose of being cleaned. The GAS and AIR pipes which I have used are both half an inch in the bore, and are ten inches long; the gas has usually had a pressure of half an inch of water, and the blast of air about ten times that pressure. The quantity of gas used in an hour was about 100 cubic feet. The stopcock which supplied it had a bore of half an inch. The round-rod, which is represented at the bottom of the burner, Fig. 1101, is intended to fit it to the support, shown by *b*, in Figs. 1115 and 1118.

When the gas is lighted and the blast of air is put on, the flame produced by the gas-burner is quite blue, and free from smoke. It is two inches in diameter, and three inches high, and the point of greatest heat is about two inches above the flat face of the gas-burner. Above this steady blue flame there rises a flickering ragged flame, several inches in height, varying with the pressure of the gas. In the blue flame, thin platinum wires fuse readily.

When the gas is burning in this manner, and the apparatus is attached to flexible tubes, the burner may be inverted or held sideways, without disturbing the force or regularity of the flame, so that the flame may be directed into a furnace at the bottom, the top, or the side, as circumstances may require.

DESCRIPTION OF THE DIFFERENT PARTS OF THE GAS FURNACE :—

1102. The following articles are used in building up the gas furnace for different experiments. They vary in size according to the volume of the crucible, or the weight of the metal which is to be heated, but I may give a general idea of them by saying that Figs. 1102 to 1114 are drawn of about one-sixth part of the actual size of the articles which they respectively represent. The scales of Figs. 1115, 1118, 1119, and 1120, are marked upon them.

Fig. 1102 represents a section of a circular plate of fire-clay, two inches thick, with a hole in the centre, exactly fitting the upper part of the gas-burner, which is made to enter into the hole three-quarters of an inch. In external diameter, this clay plate agrees with each size of furnace.

Fig. 1103 represents a section of a cylinder of fire-clay, of which two pieces are required to constitute the body of each furnace. In the middle of each cylinder, a trial-hole is made, one inch in diameter, to which a fire-clay stopper is adapted. See *c*, Fig. 1115.

Fig. 1104 is a section of a fire-clay cylinder, closed at one end, and pierced near the open end with numerous holes, of half an inch in diameter. The thickness of the clay is immaterial. There are several sizes of this cylinder for crucibles of different diameters. It is sometimes called the Ventilator. It is again represented at *a*, Fig. 1116.

Fig. 1105 represents a circular plate of fire-clay, from two to four inches in diameter, and one inch thick. Similar pieces half-inch thick are useful.

Figs. 1106 to 1108 represent cylinders of plumbago, pierced with numerous holes of three-eighths of an inch diameter. Their use is to support flanged crucibles over the flame.

Fig. 1109 is a cover, or thin plate of plumbago, three inches in diameter. It has a small hole in the middle, and being of a soft material, the hole can be easily cut or filed to suit crucibles of any desired size, so as to support them on the cylinders 1108, &c.

As in all cases the heating power of the gas furnace spreads laterally, and does not rise vertically, the most advisable form of the crucibles required for use in it is *short and broad*, not tall and narrow, and the supporting cylinders must be shaped accordingly. No fire-bars or grates can be used to support crucibles in this gas furnace, because no material, formed into narrow bars, can sufficiently withstand its powers of fusion and combustion.

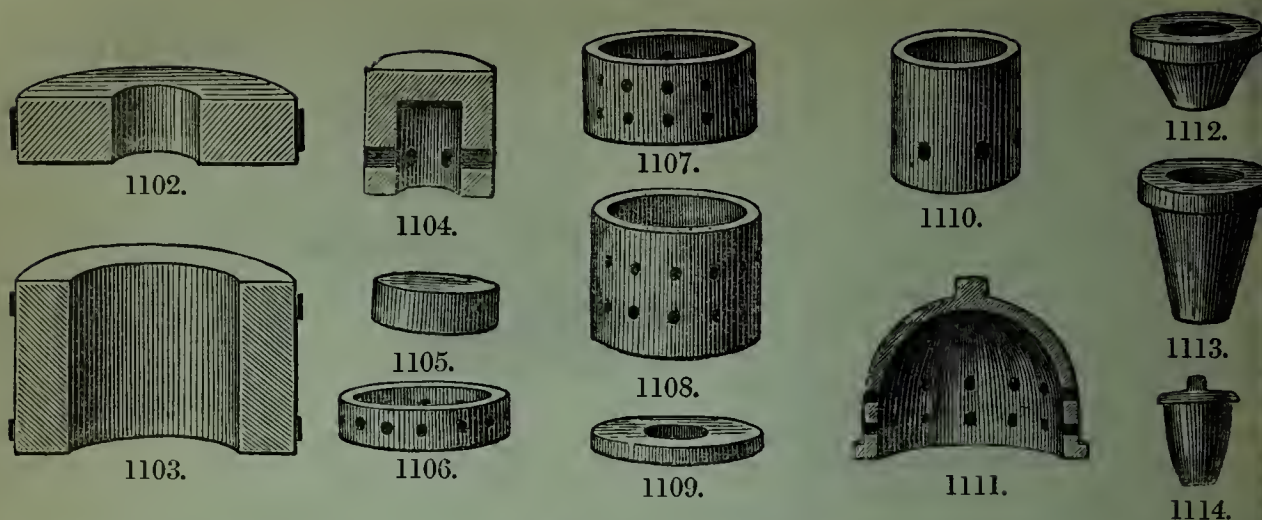


Fig. 1110 is a plumbago cylinder, or crucible-jacket, two and a half inches high, two and a half inches in diameter, and a quarter of an inch thick in the walls. It has several holes of three-eighths of an inch diameter.

Fig. 1111 represents a circular cover or dome, flanged at the bottom, and having a knob or handle at the top. It is pierced with twenty-four holes of a quarter of an inch in diameter, arranged in two rows near the bottom. This dome, when of small size, is made of plumbago. When of large size, of fire-clay.

Figs. 1112 and 1113 represent plumbago crucibles made with a flange or solid overhanging rim, the use of which is to suspend the crucibles over the gas-burner, by means of the cylinders, Figures 1106, 1107, and 1108. When the crucibles are too small to fit the cylinders, the flat plate, Fig. 1109, is filed to fit the crucible, and is then placed on the cylinder, to the diameter of which it is adapted.

Fig. 1114 is an ordinary crucible of porcelain or platinum.

Besides these pieces of fire-clay and plumbago, it is necessary to be provided with a strong iron tripod, to sustain the furnace, as represented by *c*, in Fig. 1115; an iron pan, in which to place the furnace; and a quantity of gravel, or rounded flints, not less than half an inch, nor more than one inch, in diameter. These pebbles form an essential part of this gas furnace.

GAS FURNACE, ARRANGED FOR HEATING AT THE TOP.

1115. This Gas Furnace is exhibited in section by Fig. 1115. *a* is the gas-burner, Fig. 1101; *b* is the support for it, when used below the furnace; *c* is the iron tripod support for the furnace; *d d*, are two perforated clay plates, like Fig. 1102, adapted to the gas-burner *a*; *e e* are two clay cylinders, like Fig. 1103. These pieces, *a* to *e*, are similar in all the furnaces, and will not require description in each example.

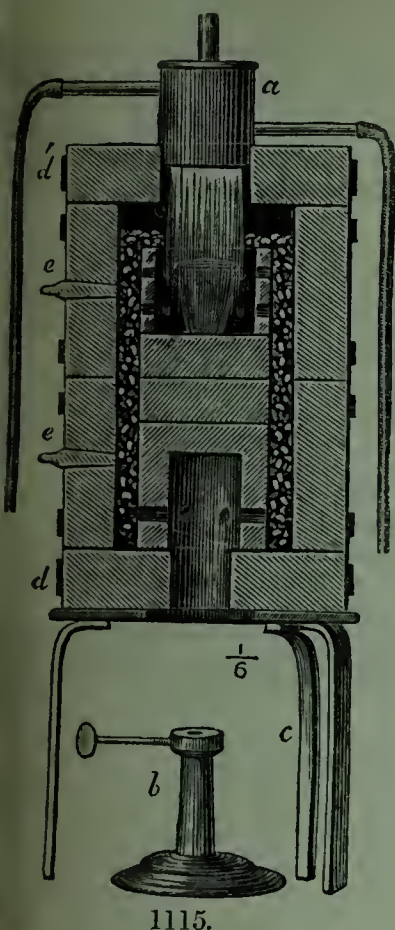
The interior of the furnace, as represented by Fig. 1115, is built up as follows:—The clay plate, *d*, is put upon the tripod, *c*. Over the central hole in *d*, the clay cylinder or ventilator, Fig. 1104, is placed, and upon that cylinder two or three of the clay plates represented by Fig. 1105. Upon these a porcelain or platinum crucible, similar to Fig. 1114, is placed. If it is of platinum, a piece of platinum foil may be put between the crucible and the uppermost clay plate, to protect the crucible from contact with particles of iron, or against fusion with the clay. The crucible is to be surrounded by the plumbago jacket, Fig. 1110. The space between this pile in the centre of the furnace and the two cylinders, *e e*, which form the walls of the furnace, is to be filled with flint-stones or gravel, washed clean and dried. The stones which answer best are rounded, water-worn pebbles, of half an inch to one inch diameter. These may be piled up to the top edge of the jacket.

1116. It has been found convenient to give the crucible jacket a conical form, the better to adapt it to the usual shape of the crucible. The four figures 1116*a*, *b*, *c*, *d*, show the method of using it, so as to make crucibles of different sizes fit the furnace properly.

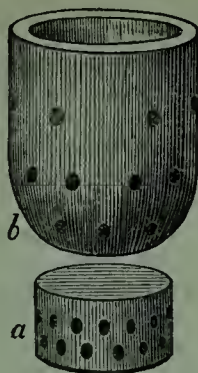
In these figures, *a* represents a ventilator or hollow support, the same as No. 1104, the sides of which are pierced full of holes. This is placed over the hole in the lower nozzle plate, to permit of the descent and escape of the carbonic acid gas and steam produced by the combustion of the gas in the furnace: *b* represents a cone open at both ends and pierced full of holes. Its use is to contain the crucible that is to be exposed to heat, as represented by *d* in Figs. 1116*b*, *c*, *d*.

The ventilator and cone together should be equal, or nearly equal, to the height of the body of the furnace. The top of the crucible should be about $2\frac{1}{2}$ inches from the flat iron face of the gas-burner, that being in general the place of greatest heat, but subject to a variation of half an inch, more or less, according to the supply of gas. The space between the crucible and cone should be about

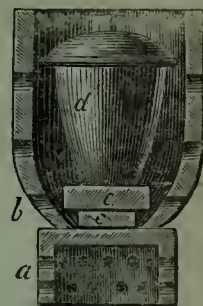
$\frac{1}{4}$ inch; if much wider the heating power of the furnace is diminished. The space between the ventilator and cone, *a*, *b*, and the sides of the furnace, must be completely filled by flints of from $\frac{1}{2}$ inch to 1 inch diameter. When the flints split up, the powder produced must be occasionally removed, as it stops the draught of the furnace. In order to raise the crucible to the proper distance



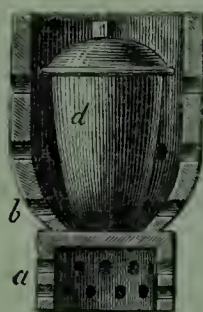
1115.



1116a.



1116c.



1116b.



1116d.

from the face of the burner, round clay plates are used: thus, *c*, Fig. 1116c, shows how to raise a crucible within a cone; and *c*, Fig. 1116d, shows how a small cone can be raised above the ventilator to the proper height. Different sizes of cones may be used in the same furnace, the cone being chosen in each operation to fit the crucible, the quantity of surrounding pebbles being of no consequence, provided the furnace is filled up to the edge of the cone.

THE PROCESS OF FUSION.

1117. The apparatus being thus arranged, the gas is to be turned on, and to be lighted; the blowing-machine is to be put into action, and the nozzle of the gas-burner is to be depressed into the central hole of the clay plate *d'*, as shown in Fig. 1115. The whole force of the blue flame then strikes the crucible; part of it forces its way through the holes in the cone or crucible jacket, and part of it rises and passes over the upper edge of the jacket; after which it forces its way downwards between the pebbles. The carbonic acid gas and the vapour of water which result from the combustion of the gas, together with the nitrogen of the air and any uncombined oxygen, accompany it. No space being left open for the escape of these gases at the upper end of the furnace, they go downwards through the interstices among the pebbles, and passing through the holes in the ventilator, *a*, Fig. 1116, and through the central hole in the lower plate, *d*, Fig. 1115, they escape finally into the air. In this progress, the hot gases give up nearly all their heat to the flint stones. Water and gases escape below at a very moderate temperature, water even runs down in the liquid state, while the stones rapidly acquire a white heat; and if the blast and the supply of gas is continued, they retain that white heat for any desired length of time—for hours.

Precautions to be observed on commencing a Fusion.—When a furnace and its contents are cold and a burner is newly lighted, it must not be suddenly plunged into the furnace, and the full heat be applied at once; otherwise the fire is apt to go out, or the crucibles and interior fittings to crack from the too sudden application of a violent heat. It is better to let the flame play a little time into the opening of the furnace, before the burner is thrust closely into its place. The crucibles and furnace fittings should be quite dry when used. It is recommended, after arranging a furnace for a fusion, first to warm it by a large gas-burner, such as No. 974 or No. 975, before applying the blast-burner.

When the furnace has thus been warmed, the full heat may be supplied safely. At the end of ten minutes after lighting the gas, the crucible, placed in the described circumstances, and exposed to the full action of the heat of the gas, and surrounded by substances which are bad conductors of heat, is raised, with the jacket and pebbles around it, to a white heat. The consequence is, that the full power of the gas-jet is then exerted upon the crucible and its contents, and those effects are produced which will be described presently.

If it is desired to inspect the substance subjected to the action of heat in this furnace, the gas-burner is lifted out, and the crucible is examined through the hole in the clay plate. To make it possible to inspect substances at a white heat, the view is taken through a piece of dark cobalt blue glass. If the substances submitted to heat suffer no harm from the action of oxygen, it is better to dispense with a crucible cover, and to direct the jet of flame directly down upon the substance to be heated. The action is then more rapid. When the burner is taken out, the substance in the crucible can be stirred, if it is considered necessary.

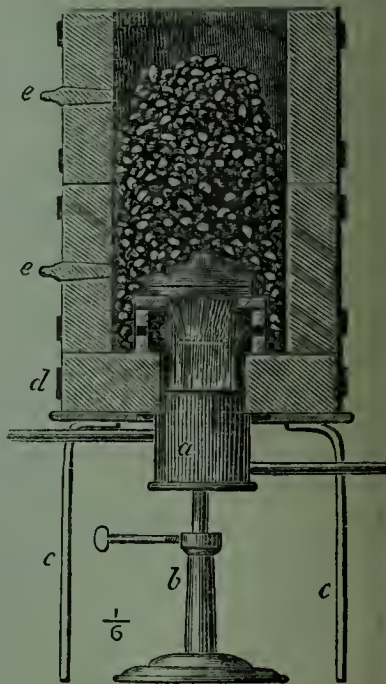
Results.—The following experiment will give an idea of the power of a furnace of this description. A common clay crucible, 3 inches high and 3 inches diameter at the mouth, was filled with about 24 ounces of cast iron. It was mounted like Fig. 1115, in a furnace of 4 inches internal diameter and 8 inches deep. The pebbles were filled in to the edge of the crucible. No crucible cover and no jacket were used. The flame was thrown directly upon the iron. In a short time the iron melted, the oxygen then converted some of the cast iron into magnetic oxide of iron, which formed a thin, infusible mass, on the surface of the cast iron. At twenty minutes from the lighting of the gas, the furnace was dismantled. The crucible was taken out. A hole was broken by an iron rod in the infusible surface of oxidized iron, and the fused cast iron below it was decanted into a mould, and made a clear casting weighing 20 ounces. In the same small furnace 32 ounces of copper were fused in fifteen minutes. When the furnace is hot, that quantity of copper or cast iron can be fused in ten minutes. In a furnace of the same dimensions, but with a gas-burner having only six instead of sixteen jets, 16 ounces of copper or of cast iron can be completely fused in ten minutes if the furnace is cold, and in seven minutes if the furnace is hot.

These experiments show that within twenty minutes a heat is producible in this little furnace which is more than sufficient for the decomposition of silicates by fusion with the carbonates of potash, soda, or barytes.

GAS FURNACE HEATED AT THE BOTTOM. Exhibited in Section by Fig. 1118.

1118. In this furnace the parts marked *a*, *b*, *c*, *d*, *e*, *e*, are the same as those similarly marked in Fig. 1115; but the gas-burner is in this case put into the bottom of the furnace instead of the top and the arrangement of the crucible and its support is altered in the manner shown by the Figure. Upon the centre of the clay plate, *d*, the perforated plumbago cylinder, represented by Fig. 1108, is placed; and upon that, a plumbago crucible of the form shown by Fig. 1112. This arrangement is represented by Fig. 1118*a*, where *a* is the cylinder, *b* the flanged crucible, and *c* the crucible cover. These are placed together in position in Fig. 1118. The size of the crucible and the height of the perforated cylinder are to be so adjusted that the bottom of the crucible shall be struck by the hottest part of the gas flame; that is to say, the space left between the face of the gas-burner and the bottom of the crucible must not exceed $2\frac{1}{2}$ inches. The crucible is provided with a closely-fitting cover, and pebbles are then filled in between the crucible jacket and the furnace cylinder, *e*, and are covered over the crucible until both the pieces of the furnace, *e*, *e*, are nearly filled. The gas is then lighted, the blast of air is set on, the gas-burner is forced up into the hole in the clay plate *d*, and the operation proceeds. In from ten to twenty minutes after the gas is lighted—this difference of time depending upon the size of the furnace and the weight of metal contained in the crucible—the interior of the lower cylinder, *e*, acquires a white heat. The progress of the operation can be watched by occasionally removing the stone peg in the trial-hole of the furnace cylinder, *e*. The heat very slowly ascends into the upper cylinder, and it never becomes so great in the upper as in the lower cylinder. The greatest fusing power of the furnace is confined within a vertical space of about 6 inches, reckoning from the bottom. The power of flint pebbles to abstract heat from the gases which pass through this apparatus is quite remarkable. When about 6 inches of pebbles lie above the crucible, and the crucible and the pebbles about it have been white-hot for half an hour, the hand can be held over the top of the furnace, within a few inches of the pebbles, without inconvenience. It becomes wetted with the vapour which rises from the furnace, but feels only a moderate degree of heat.

This form of the furnace is attended by the inconvenience that you cannot examine the condition



1118.

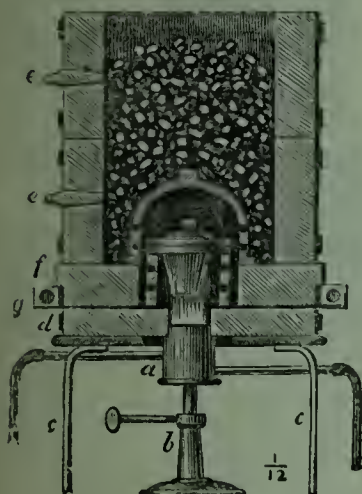
of the matter contained in the crucible, to ascertain when the heat has been continued long enough. In cases where the fusion is to be performed repeatedly on the same weight of metal, this would be of no importance, because the power of the furnace is so steady and regular, that the time of firing which has been found to answer once will answer the same purpose again.

When it is supposed that the fusion of the metal submitted to trial is completed, the gas is first to be turned off, and then the supply of air stopped. You can either allow the furnace to remain intact till it is cold, or lift off the cylinders, *e, e*, with tongs, and allow the hot stones to fall into the iron pan placed below the furnace to receive them. A few bricks should be laid between the pan and the table or stool on which it rests, if the latter is made of wood; because the heat given off by the pebbles is very great. The pebbles being raked away from the crucible, the contents of the latter can be examined.

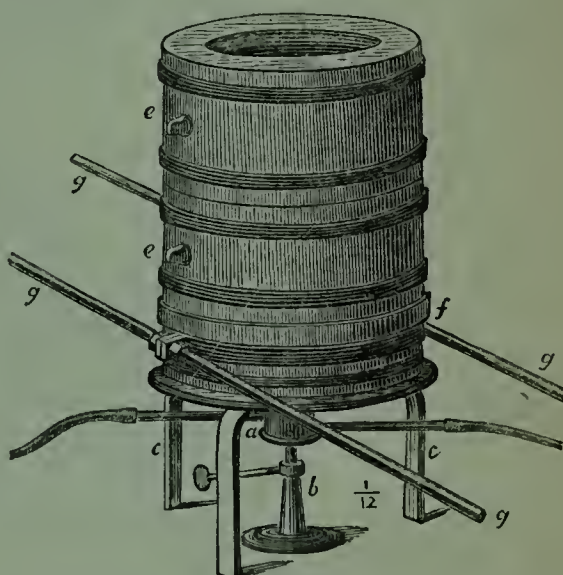


1118a.

GAS FURNACE HEATED FROM BELOW, AND PROVIDED WITH A LIFTING APPARATUS, TO AFFORD ACCESS TO THE CRUCIBLE. Exhibited in Section and in Perspective by Figs. 1119 and 1120.



1119.



1120.

1119. This modification of the furnace is contrived to afford the means of inspecting the contents of the crucible without serious interruption to the process of ignition. The apparatus is shown in section by Fig. 1119, and in perspective by Fig. 1120. Besides the pieces that are similar to those which form the other furnaces, this furnace has two additions, a *lifter* and a *dome*.

The *lifter*, represented by *f* in Figs. 1119, 1120, and separately by Fig. 1121, is a plate of fire-clay, 2 inches thick, and having a central hole, *large enough* to go easily over the crucible jackets and crucibles represented by Figs. 1106 to 1109, 1111, 1112 and 1113; and *small enough* to permit the plate to carry and lift up the *dome*, Fig. 1111, when of a sufficient size to cover the crucible without touching it. The lifter is bound with a ring of stout iron, and is screwed to two iron rods, *g, g*, of from $\frac{1}{2}$ to $\frac{3}{4}$ inch in thickness, and 3 to 4 feet in length, according to the size and weight of the furnace to be lifted.

The packing of this variety of furnace is performed as follows:—The clay plate, *d*, and the lifter, *f*, are placed upon the tripod-stand. The crucible jacket, Fig. 1108, or one similar, but of larger size, is placed upon the plate, *d*. The crucible and its cover is then put into its place, and is covered with the dome, Fig. 1111, which must rest upon the lifter, *f*, and must be of such a width as to clear the crucible easily when lifted. The internal height of the dome should be such as just to clear the top of the crucible cover. Consequently, where crucibles of different sizes are used, domes of different sizes are also necessary. Observe, distinctly, that the crucible and its support are to rest upon the plate, *d*, and the dome upon the lifter, *f*. The furnace cylinders, *e, e*, are now to be superposed, and the space between the dome and the cylinders, and that above the dome, are to be filled with small pebbles, as already directed, and as represented by Fig. 1119. The gas may then be lighted, the blast of air set on, and the operation be allowed to proceed.



1121.

When the ignition has been continued as long as is considered necessary, or when you wish to inspect the contents of the crucible, the gas is to be turned off, the blast of air stopped, and two men, holding the bars, *g, g*, are steadily to lift up the whole upper part of the furnace; namely, the lifter, *f*, the two cylinders, *e, e*, the dome, and the pebbles; leaving the clay plate, *d*, with the crucible and its jacket, both at a white heat, standing clear in the middle. This separation is represented in Fig. 1123, but the separation is there effected in another manner. The cover of the crucible is then to be lifted, and the contents examined. If the fusion is not completed, the furnace is to be carefully lowered into its former position, the gas is to be turned on, and the blast renewed. This interruption of the process scarcely occupies a minute. I have already mentioned that for the convenient inspection of the crucible at a white heat, it is necessary to look at it through a piece of dark-blue glass.

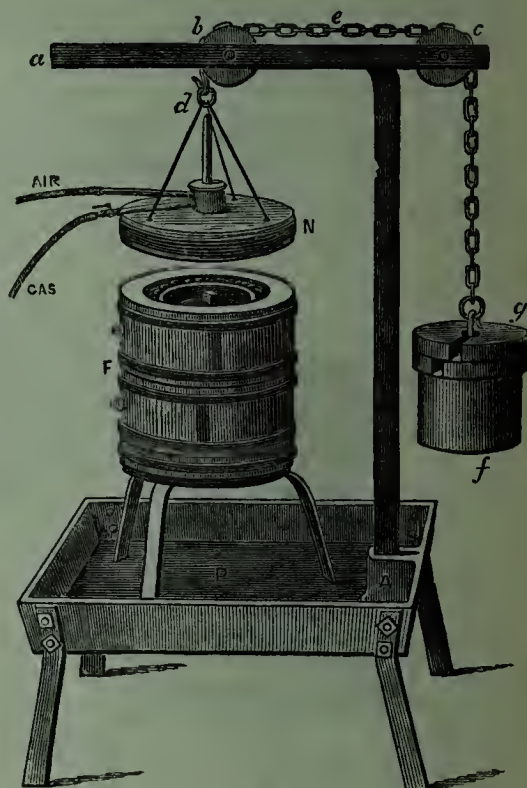
CRANE LIFTING APPARATUS.

1122. For all sizes of Furnaces the methods of LIFTING represented by Figs. 1122 and 1123 are to be preferred to that described above.

Fig. 1122 represents a contrivance for lifting the nozzle-plate and gas-burner when the heat is applied at the top of the furnace. Fig. 1123 represents a method of lifting the entire furnace from the crucible when the heat is applied below. In both cases the crane and all its supports can be swung round on the point *A*, by the hand applied at *a*, to give free access to the crucible. The weights *f, g*, acting together, cause the furnace *F*, or the nozzle-plate *N*, to rise. When the weight *g* is removed, the furnace *F*, or the nozzle-plate *N*, descends. *e* represents an iron chain that runs over the pulleys, *b, c*.

The same pan and crane answer for both operations; but in one case the weights *f, g* counterbalance only the nozzle-plate and burner, *d, N*, Fig. 1122; and in the other case, they are much heavier, in order to counterbalance the loaded furnace, *d, F*, Fig. 1123.

These two Figures exhibit the furnace in its complete state: Fig. 1122, arranged for heating at the top; and 1123, arranged for heating at the bottom. Both Figures show the iron pan which has been found useful with this furnace.



1122.

POWER OF THE BLAST GAS FURNACES.

1123. The Figures of the gas furnaces are drawn to scales, which show the relative proportions of the different parts. The absolute sizes of the furnaces depend upon the amount of work required from them. The fusions described below were mostly made in a furnace of 6 inches internal diameter, a few in a furnace of 4 inches internal diameter, and one or two in a furnace of 8 inches internal diameter; all of them with a gas-burner of sixteen holes, and a supply of gas obtained from a $\frac{1}{2}$ -inch pipe. A large furnace on the plan of Fig. 1119, and with an internal diameter of 112 inches, will demand a gas-burner of twenty-six holes, and a supply of gas from a pipe of nearly 1 inch in the bore. Such a furnace will completely fuse $\frac{1}{4}$ cwt. of cast iron.

The fusing points of certain metals have been fixed by Daniell at the following temperatures:—

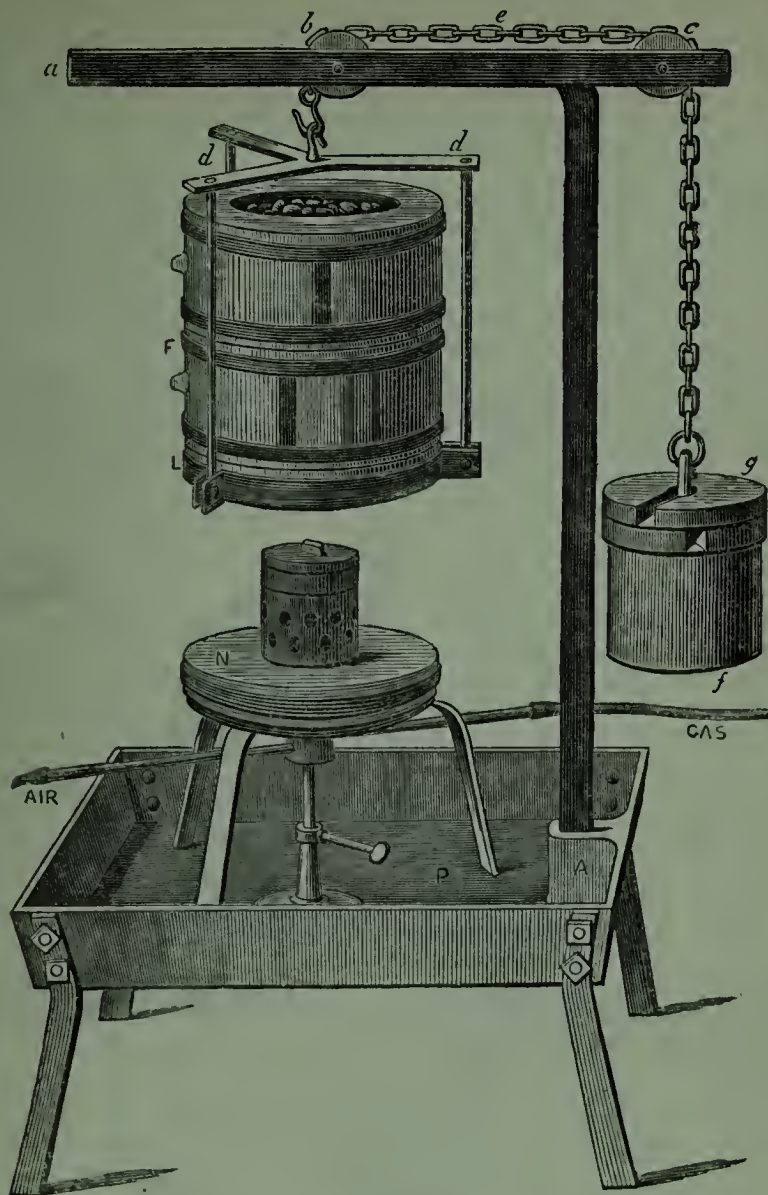
Silver	1873° F.	Copper	1996° F.
Gold	2016°	Cast iron	2786°

Brass, with 25 per cent. of zinc, at 1750° F.

All these metals melt readily in the gas-furnace. Quantities of 3 lb. of copper or cast iron can be completely fused in fifteen minutes in a 6-inch furnace. Quantities of 8 or 10 lb. of copper or cast iron can be completely fused into a homogeneous mass in a 6-inch or 8-inch furnace within one hour, using a sixteen-hole burner, and a supply of gas from a $\frac{1}{2}$ -inch pipe.

In a furnace of the same size I have fused 45 ounces of nickel, and in other experiments I have produced masses of wrought iron weighing 18 ounces, 28 ounces, and 40 ounces. The piece of 18 ounces was perfectly fused. The piece of 40 ounces was not quite fused, the crucible having melted, and stopped the operation. I have also fused cobalt, and reduced it to the metallic state from the peroxide by ignition with charcoal. The time required for the fusion of these refractory metals is from one and a half to two hours.

When the metals to be melted are such as do not undergo oxidation, the method of action represented by Fig. 1115 is most convenient. In this manner gold can be readily melted, and by removing the gas-burner the melted metal can be stirred. When the action of oxygen is to be avoided, the crucible must have a cover, which in some cases should be securely luted to it.



1123.

1124. *Choice of Crucibles.*—The experiments above referred to were made with coal gas at the ordinary pressure, and with a blast of cold atmospheric air. Greater effects can be produced by the use of oxygen gas, or of heated atmospheric air. But a difficulty stands in the way of the use of these greater degrees of heat in the want of crucibles capable of enduring their action.

With cold atmospheric air, pure nickel and pure iron dissolve every kind of siliceous crucible, and it is therefore needless to heat the air or to prepare oxygen till a superior kind of crucible is obtainable. At present, these metals can only be melted in plumbago crucibles, which necessarily communicate to them more or less carbon.

Metals which melt at moderate degrees of heat, such as gold and copper, are easily fused either in clay crucibles, or in those of plumbago; the latter, be it remembered, being a mixture of graphite and clay. Metals in combination with carbon, such as cast iron, also melt readily in clay crucibles, without destroying them. But when such metals as iron, nickel, and cobalt are freed from carbon, and brought into a state of purity, they acquire an extraordinary attraction for silica at a white heat, so that the metal and the silica readily run down into a very fusible silicate. Even when plumbago crucibles are used, the carbon burns away at some particular point; the metal then attacks the clay, bores a hole through the crucible, and finishes the operation. No kind of clay or porcelain will withstand the action of pure iron or nickel at a white heat. It is therefore impossible to effect any large fusions of these metals when they are free from carbon, or when they are heated in

crucibles that are free from carbon. It is necessary to have crucibles made of lime free from silica to effect the fusion of such metals.

1125. *Miscellaneous Uses of the Blast Gas Furnace.*—1. The preparation of chemical substances by the projection of mixtures into a crucible kept at a red or white heat. 2. For melting silver, gold, copper, cast iron, brass, bronze, nickel-silver, &c., either for making small castings or ingots. 3. For experiments on glass; every description of which it is able to fuse. 4. For experiments on enamels, coloured glasses, and artificial gems. 5. For experiments on metallic alloys. 6. For the fusion of steel. 7. For the use of dentists. 8. For the assay of ores of silver, copper, lead, tin, iron, and other metals. 9. For all purposes of ignition, combustion, fusion, or dry distillation, at a red heat, or a white heat, where it is desirable to produce those temperatures promptly, certainly, steadily, conveniently, and cheaply.

Distillation per descensum.—Suppose a stoneware bottle with a long neck to be fitted with a stoneware tube, passing nearly to the bottom of the bottle, and projecting some inches beyond its mouth. Suppose this bottle to be half filled with metallic zinc, and then to be fixed upside down in the furnace, Fig. 1115, with the tube projecting downwards through the hole in the plate *d*, and nearly dipping into a vessel of water. The furnace being packed with pebbles, and the heat applied at the top, the distillation of zinc *per descensum* then takes place.

Exhibition of Coloured Flames.—When the gas-burner, Fig. 1101, is supplied with gas and air, and is inflamed in the open air, so as to produce a clear blue flame of 3 inches long, and beyond it a flickering, nearly colourless flame of 12 inches long, brilliant colours may be given to this flame by the introduction of concentrated solutions of certain salts. A ball of pumice-stone, an inch in diameter, fastened to a stout iron wire, is dipped into the saline solution, and while wet is plunged into the flame, upon which the whole flame becomes coloured. An iron crook is used to give an oblique direction to the flame of the gas-burner, in order that powders and liquids put into the flame may not fall into the holes of the burner. Fig. 1126 represents the crook, and Fig. 1127 the manner of its adaptation to the burner and stool.

Brilliant flames are produced by throwing iron turnings into the flame; also by finely-pounded charcoal, resin, lycopodium, &c.

To produce Coloured Flames, the following solutions are used:—

1. *Chloride of Strontium* gives a brilliant crimson flame; 2. *Chloride of Calcium*, a reddish orange flame; 3. *Chloride of Sodium*, brilliant yellow; 4. *Chloride of Copper*, bluish green. For No. 4, the pumice-stone must be mounted on a copper wire. If the flame is touched on one side with the copper solution, and on the other with the strontium solution, half the flame is green and half crimson. The colours and reflections of these flames are necessarily most brilliant in a dark room. A remarkable effect is produced by the yellow soda flame. It is reflected from the human countenance with a ghastly blackness, and the light is so powerful as to give the appearance of bronze to an assembly of several hundred people; while all the bright colours of dress, scarlets, mauves, magentas, and the like, disappear instantly.

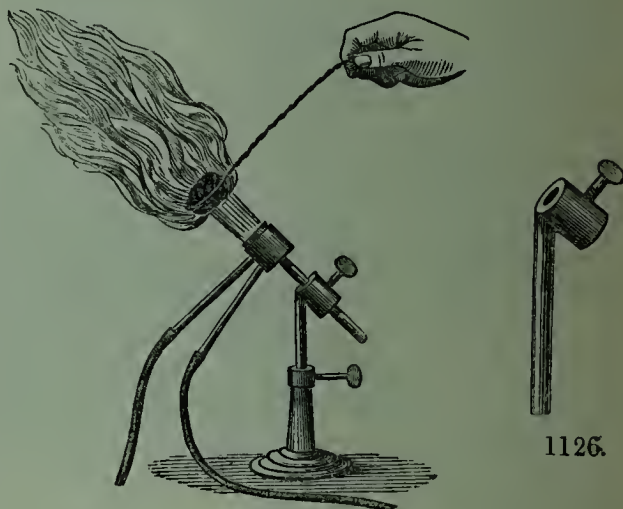
1127. *Repair of the Gas Furnace.*—When the clay cylinders become warped or chipped, so as to allow the gases to escape at the joints laterally, they must be luted for each operation by applying a little wet fire-clay by means of a spatula. When only a moderate heat is required, this luting is unnecessary.

PRICES OF BLAST GAS-BURNERS AND FURNACES, AND THEIR SEPARATE PIECES.

1128. BLAST GAS-BURNERS, each with an iron support, Fig. 1101, and *b*, Fig. 1115. 6 jets, 12s.; 16 jets, 16s.; 26 jets, 24s.

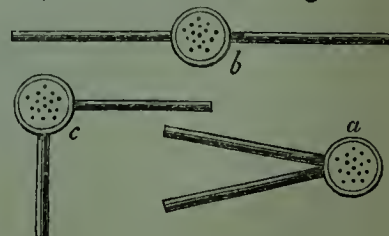
1129. The burner with 16 jets is suitable for the furnaces Nos. 1, 2, and 3. The burner with 26 jets is suitable for the furnace No. 4. The burner with 6 jets is only suitable for small crucible work. The gas supply-pipe for the burner with 16 jets must have a bore of $\frac{3}{4}$ -inch, and that for the larger burner a bore of $\frac{3}{4}$ to 1 inch.

In Fig. 1101, the gas and air are represented as being supplied to the burner on two opposite sides; but it is sometimes convenient to have the supply-pipes placed at right angles to one



1126.

1127.



1129.

another, as shown at *c*, Fig. 1129, and sometimes nearly parallel, as at *a*, Fig. 1129. It depends upon the locality where the furnace is to be used.

1130. Vulcanized Caoutchouc Tube, for connecting the gas-burner with the blower and with the gas-pipes, $\frac{1}{2}$ inch in the bore, *per foot*, 1s.

1131. Ditto, $\frac{3}{4}$ inch bore, for the furnace No. 4, *per foot*, 1s. 4d.

Two pieces of not less than 4 feet each are required.

1132. IRON CROOK, for giving an oblique direction to the gas flame, Fig. 1126, 1s.

1133. FIRE-CLAY FURNACES, similar to the external clay pieces represented by *d, d*, and *e, e*, in Fig. 1115, and separately by Figs. 1102 and 1103. Each furnace consists of two nozzle-plates, *d, d*; two cylinders, *e, e*; and two pegs for the trial-holes. The dimensions are nearly as follows:—

—	Inner Dimensions, or Fire Room.		Outside Dimensions.		Price.
	High.	Wide.	High.	Wide.	
No. 1	8 inches	4 inches	11 inches	6 $\frac{1}{2}$ inches	9s.
No. 2	8 inches	6 $\frac{1}{2}$ inches	11 inches	9 $\frac{1}{2}$ inches	12s. 6d.
No. 3	10 inches	8 inches	12 inches	12 inches	21s.
No. 4	12 inches	12 inches	16 inches	16 inches	31s. 6d.

Any of the pieces may be purchased separately.

1134. IRON TRIPODS FOR SUPPORTING THE FURNACE, similar to letter *c*, in Fig. 1115.

Cast-iron tops, with strong wrought-iron legs. Height of them all 10 inches.

The following Diameters suit the four sizes of the furnace:—

No. 1, 8 inches	5s.	No. 3, 12 inches	9s.
No. 2, 10 inches	7s.	No. 4, 16 inches	12s.

1135. CAST-IRON PANS in which to place the furnace on its tripod when in operation:—

a. Pan to suit all sizes of the furnace, letter *p*, Figs. 1122 and 1123; length, 30 inches; width, 20 inches; depth, 4 inches; with four short legs to permit bricks to be placed between the pan and the table, 16s.

b. The same Pan, with four iron legs, bolted to the pan, and removable at pleasure. These bring the pan to a convenient height from the floor, when the Lifting Apparatus is to be used, Fig. 1123, 27s.

1136. LIFTING APPARATUS for opening the furnace, to permit of the inspection of substances while undergoing ignition, and consisting of a Clay Plate 2 inches thick, mounted with strong wrought-iron fittings, as represented by Fig. 1121, and by *f, g*, Figs. 1119 and 1120.

No. 2, suitable for the Furnace No. 2.	.	.	10s. 6d.
No. 3, suitable for the Furnace No. 3.	.	..	12s.
No. 4, suitable for the Furnace No. 4.	.	.	15s.

The lifter for No. 4 can only be used when the heat required is so low as to be producible with one furnace cylinder, because the entire furnace when filled with stones is too heavy to be lifted conveniently when the contents are white hot.

This Lifting Apparatus is not required when the following is employed.

1137. CRANE LIFTING APPARATUS, as described in No. 1122, and represented in Figs. 1122 and 1123, in sets, each comprehending a pan on long legs, a crane with two pulleys, chain, weights, and hooks for the nozzle plate, frame for lifting the entire furnace with chain and weights, and iron-bound fire-clay lifter, in short, the entire sets complete for lifting the burner and nozzle plate, as shown by Fig. 1122, and for lifting the entire furnace, as shown by Fig. 1123.

No. 2, suitable for the Furnace No. 2.	.	.	£3 3s.
No. 3, suitable for the Furnace No. 3.	.	.	£4 4s.
No. 4, suitable for the Furnace No. 4.	.	.	£5 5s.

INTERIOR FITTINGS FOR THE GAS FURNACE.

A. PIECES FOR USE WHEN THE FURNACE IS HEATED AT THE BOTTOM.

1138. PERFORATED PLUMBAGO CYLINDERS FOR SUPPORTING FLANGED CRUCIBLES, Figs. 1106 to 1108.

The Numbers 1 to 4 show for what furnaces the fittings are adapted ; and the letters A, B, show the correspondence of the cylinders and crucibles.

No. 1 A, $2\frac{1}{2}$ in. high, $2\frac{1}{2}$ in. wide	9d.	No. 3 A, $3\frac{1}{2}$ in. high, 5 in. wide	2s. 6d.
1 B, 3 „ 3 „	1s. 3d.	3 B, 5 „ 5 „	3s. 6d.
2 A, $3\frac{1}{2}$ „ 4 „	2s.	4 A, 5 „ $6\frac{3}{4}$ „	4s. 6d.
2 B, 5 „ 4 „	2s. 6d.	4 B, $7\frac{1}{2}$ „ $8\frac{1}{2}$ „	8s.

1139. FLAT PLUMBAGO PLATES, with hole in the centre, Fig. 1109, occasionally useful to adapt small crucibles to cylinders that are too wide for them :—
3 inches diameter, 4d. ; 4 inches diameter, 5d.

1140. FLANGED CRUCIBLES, to fit the cylinders that have the same number :—

No.	Height.	Extreme Diameter.	PLUMBAGO.		FIRE-CLAY.	
			Crucibles.	Covers.	Crucibles.	Covers.
1 B	3 inch.	3 inch.	1s.	4d.	4d.	2d.
2 A	3 inch.	4 inch.	1s. 3d.	6d.	5d.	2d.
2 B	$4\frac{1}{2}$ inch.	4 inch.	2s.	6d.	8d.	2d.
3 A	3 inch.	5 inch.	2s. 9d.	9d.	9d.	3d.
3 B	$4\frac{1}{2}$ inch.	5 inch.	3s.	9d.	1s.	3d.
4 A	$4\frac{1}{2}$ inch.	$6\frac{3}{4}$ inch.	4s. 6d.	1s.	1s. 5d.	4d.
4 B	7 inch.	$8\frac{1}{2}$ inch.	8s.	2s.	2s. 6d.	6d.

1141. PERFORATED DOMES (Fire-Clay), Fig. 1111.

No. 2,	$5\frac{1}{2}$ inches diameter,	$5\frac{1}{4}$ inches height inside,	3s.
3,	$7\frac{1}{2}$ „	$5\frac{1}{2}$ „	4s.
4 A,	$9\frac{1}{2}$ „	$5\frac{1}{2}$ „	6s.
4 B,	11 „	8 „	8s.

B. PIECES FOR USE WHEN THE FURNACE IS HEATED AT THE TOP.

1142. VENTILATORS, or Hollow Perforated Supports for Cones, made of fire-clay, letter a, Fig. 1116 and Fig. 1104.

No. 1, 3 in. wide, 3 in. high,	9d.	No. 4, $4\frac{1}{2}$ in. wide, $2\frac{1}{2}$ in. high.	1s. 4d.
2, $3\frac{1}{2}$ „ 2 „	1s.	4, 6 „ $2\frac{1}{2}$ „	2s.

1143. PERFORATED FIRE-CLAY CONES, letter *b*, Fig. 1116, *a*, *b*, *c*, *d*.No. 2, 6 inches high, $5\frac{3}{4}$ inches upper diameter, 2s.3, $7\frac{1}{2}$ " " $6\frac{1}{2}$ " " 3s.4, $9\frac{1}{2}$ " " 9 " " 5s.

No cone is prepared for Furnace No. 1, because the small crucibles suitable for that furnace are best heated in the plumbago cylinders No. 1138, 1 A, and 1 B.

1144. ROUND CLAY PLATES for Adjusting Crucibles to Cones and to the Gas Burner, &c., Fig. 1105:—

<i>Half an inch thick:</i>				<i>One inch thick:</i>			
2 inches diameter		2d.		2 inches diameter		2d.	
3 " "		2d.		3 " "		2d.	
4 " "		3d.		4 " "		3d.	

1145. CRUCIBLES.—As the crucibles heated from above stand firmly upon a solid plate of clay, crucibles of any required form or material may be employed—platinum, porcelain, clay, plumbago, &c. In the following "Estimates" common round fire-clay crucibles are quoted; but plumbago crucibles or other kinds of suitable sizes can be supplied if required. See Catalogue of Crucibles, commencing at No. 1320.

1146. ROUND WATER-WORN FLINTS, from half-inch to 1-inch diameter, for working the Gas Furnace:

Half a cubic foot, 1s.

packing case, 1s. 6d.

A cubic foot, 2s.

packing case, 2s. 6d.

Half a cubic foot of pebbles suffices for working the furnaces Nos. 1 and 2. The others require a cubic foot. Though rounded pebbles give the best draught, angular gravel can also be used. But stones that agglutinate when heated, or which readily fall to powder, are unsuitable. The power of the gas furnace depends in a considerable degree upon the proper packing of the pebbles.

COMPLETE GAS FURNACES.

These Estimates include *specimens* of the INTERIOR FITTINGS, and a few CRUCIBLES of the sizes suitable for each Furnace, Nos. 1 to 4.

When purchasers wish to have *quantities* of CRUCIBLES, or additional pieces of such articles as most readily burn away, they are requested to give orders accordingly.

Blowing Machines are not included in the Estimates. See Section on Blowing Machines at No. 1162.

1147. Furnace No. 1 includes the following articles. Price £2 2s.

Fire-clay Furnace, 4 pieces, iron bound, 9s.

Gas Burner, 16 jets, with support, 16s.

Iron Crook, 1s.

Tripod Support for the furnace, 5s.

INTERIOR FITTINGS.

1. Ventilator, 3 inches high, 3 inches wide, 9d.

1 A. Plumbago Cylinder, $2\frac{1}{2}$ by $2\frac{1}{2}$ inches, 9d.

1 B. Ditto ditto 3 by 3 inches, 1s. 3d.

This cylinder will take in a crucible measuring $2\frac{1}{4}$ inches wide by $2\frac{3}{4}$ inches high, the largest suitable for this size of furnace.

- 1 B. Flanged Crucible and Cover, plumbago, 1s. 4d.
- 1 B. Flanged Crucible and Cover, fire clay, 2 *sets*, 1s.
- Clay Plates, 2 inches by $\frac{1}{2}$ inch and 1 inch, 2 *each*, 8d.
- „ 3 inches by $\frac{1}{2}$ inch and 1 inch, 2 *each*, 8d.
- Round Fire-clay Crucible, *six*, with covers, 1s. 1d.
- Plumbago Crucible, No. 1, *two*, with covers, 1s.
- Round Flints, $\frac{1}{2}$ cubic foot, in packing case, 2s. 6d.

1148. Furnace No. 2. Price £6 6s.

Fire-clay Furnace, 4 pieces, iron bound, 12s. 6d.

Gas Burner, 16 sets, with support, 16s.

Iron Crook, 1s.

Tripod Support for the furnace, 7s.

Crane Lifting Apparatus, No. 1137, £3 3s.

INTERIOR FITTINGS FOR FURNACE No. 2.

No. 2. Ventilator, $3\frac{1}{2}$ inches wide, 2 inches high, 1s.

2. Cone, 6 inches high, $5\frac{3}{4}$ inches upper diameter, 2s.

2. Dome, $5\frac{1}{2}$ inches diameter, 3s.

2 A. Flanged Crucible and Cover, plumbago, 1s. 9d.

2 A. Flanged Crucible and Cover, clay, 2 *sets*, 1s. 2d.

2 B. Flanged Crucible and Cover, plumbago, 2s. 6d.

2 B. Flanged Crucible and Cover, clay, 2 *sets*, 1s. 8d.

1 A. Plumbago Cylinder, $2\frac{1}{2}$ inches high, $2\frac{1}{2}$ inches wide, 9d.

1 B. Ditto, 3 inches high, 3 inches wide, 1s. 3d.

2 A. Ditto, $3\frac{1}{2}$ inches high, 4 inches wide, 2s.

2 B. Ditto, 5 inches high, 4 inches wide, 2s. 6d.

Clay Plates, 2 inches by $\frac{1}{2}$ inch and 1 inch, 2 *each*, 8d.

Ditto, 3 „ by $\frac{1}{2}$ inch and 1 inch, 2 *each*, 8d.

Plumbago Plate, 3 inch, 2 *copies*, 8d.

Round Fire-clay Crucibles, for cone No. 2, all with covers, 3 each of $4\frac{3}{4}$ inches high, $4\frac{1}{4}$ inches high, $3\frac{1}{2}$ inches high, 3s.

Round Flints, $\frac{1}{2}$ cubic foot, in packing case, 2s. 6d.

1149. FURNACE No. 2, without the Crane Lifter and Pan No. 1137, but with the Lifter No. 1136, £3 13s. 6d.

1150. Furnace No. 3. Price £8 18s. 6d.

Fire-clay Furnace, 4 pieces, iron bound, £1 1s.

Gas Burner, 16 jets, with support, 16s.

Iron Crook, 1s.

Tripod Support for the Furnace, 9s.

Crane Lifting Apparatus, No. 1137, £4 4s.

INTERIOR FITTINGS.

No. 3. Ventilator, $4\frac{1}{2}$ inches wide, $2\frac{1}{2}$ inches high, 1s. 4d.

3. Perforated Cone, $7\frac{1}{2}$ inches high, $6\frac{1}{2}$ inches upper diameter, 3s.

2. Ventilator, $3\frac{1}{2}$ inches wide, 2 inches high, 1s.

2. Perforated Cone, 6 inches high, $5\frac{3}{4}$ inches upper diameter, 2s.

3. Dome, $7\frac{1}{2}$ inches diameter, two copies, 8s.

1 A. Perforated Cylinder, $2\frac{1}{2}$ inches high, $2\frac{1}{2}$ inches diameter, 9d.

1 B. Ditto, 3 inches high, 3 inches diameter, 1s. 3d.

3 A. Ditto, $3\frac{1}{2}$ inches high, 5 inches diameter, 2s. 6d.

3 B. Ditto, 5 inches high, 5 inches diameter, 3s. 6d.

Perforated Plumbago Plates, 3 inch, 2 *copies*, 8d.

Ditto, 4 inch, 2 *copies*, 10d.

- 3 A. Flanged Crucible and Cover, plumbago, 3s. 6d.
 3 A. Flanged Crucible and Cover, fire-clay, 2 *sets*, 2s.
 3 B. Flanged Crucible and Cover, plumbago, 3s. 9d.
 3 B. Flanged Crucible and Cover, fire-clay, 2 *sets*, 2s. 6d.
 Clay Plates, 2 by $\frac{1}{2}$ inch, and 2 by 1 inch, 2 *each*, 8d.
 Ditto, 3 by $\frac{1}{2}$ inch, and 3 by 1 inch, 2 *each*, 8d.
 Ditto, 4 by $\frac{1}{2}$ inch, and 4 by 1 inch, 2 *each*, 1s.
 Round Fire-clay Crucibles to fit Cone No. 3, all with covers, 3 of $5\frac{1}{4}$ inches, 1s. 4d.; 3 of $6\frac{1}{2}$ inches, 1s. 9d.
 Round Fire-clay Crucibles to fit Cone No. 2, all with covers; 3 of $4\frac{3}{4}$ inches, 1s. 2d.; 3 of $4\frac{1}{4}$ inches, 10d.
 Round Pebbles, 1 cubic foot, in packing case, 4s. 6d.
 1151. FURNACE No. 3, without the Crane Lifter and Pan No. 1137, but with the Lifter No. 1136, £5 5s.

1152. Furnace No. 4. Price £12 12s.

- Fire-clay Furnace, 4 pieces, iron bound, £1 11s. 6d.
 Gas Burner, 26 jets, with supports, £1 4s.
 Iron Crook, 1s.
 Tripod Stand for the furnace, 12s.
 Crane Lifting Apparatus, No. 1137, £5 5s.

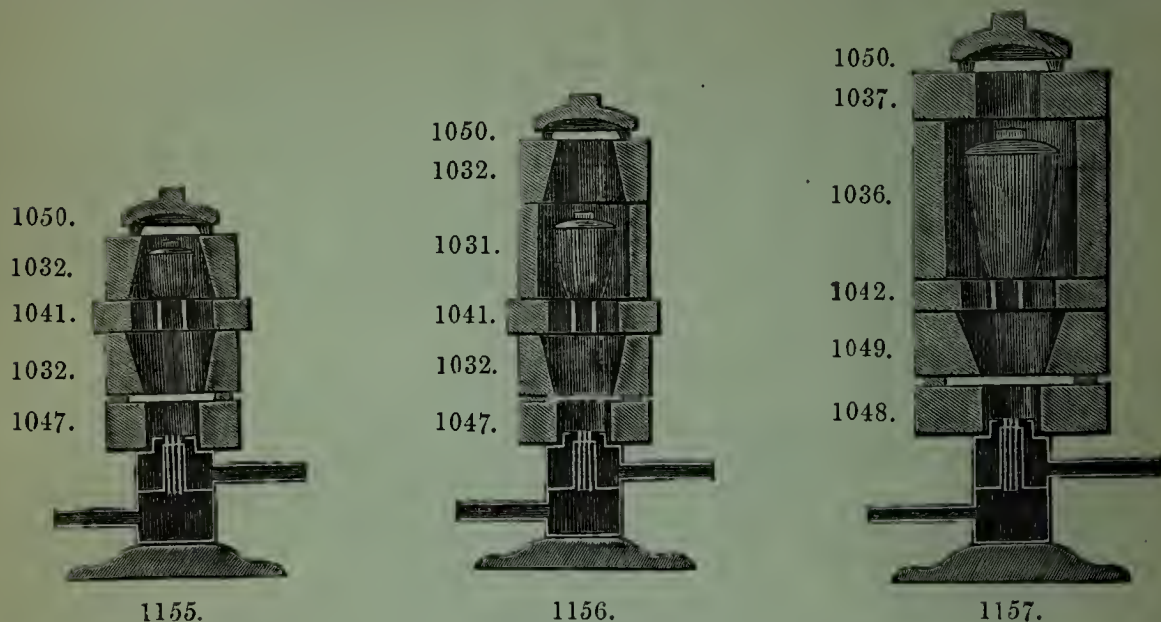
INTERIOR FITTINGS.

- No. 4. Ventilator, 6 inches wide, $2\frac{1}{2}$ inches high, 2s.
 4. Perforated Cone, $9\frac{1}{2}$ inches high, 9 inches upper diameter, 5s.
 3. Perforated Cone, $7\frac{1}{2}$ inches high, $6\frac{1}{2}$ inches upper diameter, 3s.
 4 A. Dome, $9\frac{1}{2}$ inches diameter, 2 *copies*, 12s.
 4 B. Dome, 11 inches diameter, 8s.
 1 B. Perforated Cylinder, 3 inches high, 3 inches wide, 1s. 3d.
 4 A. Ditto, 5 inches high, $6\frac{3}{4}$ inches wide, 4s. 6d.
 4 B. Ditto, $7\frac{1}{2}$ inches high, $8\frac{1}{2}$ inches wide, 8s.
 Perforated Plumbago Plate, 4 inches, 2 *copies*, 10d.
 4 A. Flanged Crucible and Cover, plumbago, 5s. 6d.
 4 A. Flanged Crucible and Cover, fire-clay, 1s. 9d.
 4 B. Flanged Crucible and Cover, plumbago, 10s.
 4 B. Flanged Crucible and Cover, fire-clay, 3s.
 Clay Plates, 3 by $\frac{1}{2}$ inch, and 3 by 1 inch, 3 *each*, 1s.
 Ditto, 4 by $\frac{1}{2}$ inch, and 4 by 1 inch, 3 *each*, 1s. 6d.
 Round Fire-clay Crucibles to fit Cone No. 4, all with covers; 3 of $7\frac{1}{4}$ inches, 2s. 6d.; 3 of $8\frac{1}{4}$ inches, 3s. 4d.
 Round Fire-clay Crucibles to fit Cone No. 3, all with covers; 3 of $5\frac{1}{4}$ inches; 1s. 4d.; 3 of $6\frac{1}{2}$ inches, 1s. 8d.
 Round Flints, 1 cubic foot, in packing case, 4s. 6d.
 1153. FURNACE No. 4, without the Crane Lifter and Pan No. 1137, but with the Lifter No. 1136, £8.

Miniature Blast Gas Furnaces.

1155. Many chemical ignitions, performed on small quantities of substances in analytical processes, demand a degree of heat greater than that afforded by gas-burners with draught, but not so much as is supplied by the powerful blast furnaces described in the preceding section. The apparatus now to be described is intended to meet this requirement. It will readily raise to a white heat all the sizes of platinum and porcelain crucibles that are commonly in use, and such sizes of clay or plumbago crucibles as will contain a pound of cast iron, which quantity of metal this furnace will melt.

Figures 1155, 1156, and 1157, represent three examples of the MINIATURE BLAST FURNACE. This consists, in the main, of a Blast Gas-burner, similar in construction to that represented by Fig. 1101, but smaller in size, and having only three jets. It is fixed upon, and forms part of, the furnace support, as represented in the figures. Upon the iron nozzle of the burner there is fixed a fire-clay nozzle plate, or furnace-sole, similar to *d* Fig. 1115, and upon this plate the little furnace is built up



of loose clay cylinders, such as are described in articles 1018 to 1050, and which are in all cases selected to suit the size of the crucible that is to be operated upon. The entire furnace rests on the solid shoulder of the gas-burner. No pebbles are used, the degree of heat that is intended to be raised not requiring their aid. Gas supplied at common pressure by a $\frac{1}{4}$ -inch pipe is sufficient.

In mounting this furnace, it is necessary to place between the nozzle plate, or sole, and the conical flue placed upon it, three small feet, to separate the two pieces and give room for the influx of atmospheric air around the flame, without which the proper heat of the furnace is not obtained. Three bronze halfpenny pieces answer the purpose exactly.

Upon comparing the three figures, 1155, 1156, 1157, it will be perceived that the interior of the furnace is exactly alike up to the grate, or trivet, and differ above that only in having cylinders that suit the different sizes of crucibles that are to be heated.

It is in the power of the operator, when working with platinum crucibles, to dispense with the grate, and to hang his crucible in the hottest part of the furnace, by a sling of platinum wire suspended from an iron bar laid across the top of the furnace. The piece marked 1041, in Fig. 1155, being omitted, the two pieces, 1032 and 1032, come together and form a cavity, in the centre of which the crucible is to be suspended. If it then appears to be too low in the flame, the height can be raised by putting such pieces as 1024, or 1025, between the lower piece, 1032, and the sole, 1047.

1155. Gas-burner and Furnace for crucibles not exceeding 2 inches by 2 inches. The fire-clay pieces are 4 inches in external diameter, price 12s. 6d.

1156. Gas-Burner and Furnace for crucibles not exceeding $2\frac{3}{4}$ inches by $2\frac{3}{4}$ inches. This includes the same pieces as No. 1155, with the addition of a cylinder 4 by 4 inches, to make room for the larger crucible, price 14s.

1157. Gas-burner and Furnace for crucibles not exceeding $3\frac{1}{2}$ inches by $3\frac{1}{2}$ inches. All the pieces are 6 inches in external diameter; price 16s.

1158. The three Furnaces combined, that is to say, one burner, one of each size of nozzle plate, and one set of the other fittings, both of the 4-inch and 6-inch diameter, so as to fit up any one of the furnaces represented in the three figures; price 23s.

1159. The three-jet Gas-Burner, mounted on the Iron Stand, without the fire-clay furnaces; price 7s. 6d.

The prices of all the clay cylinders are given at Nos. 1023 to 1050, being the Nos. referred to at the side of the above figures. Duplicates of the grates, or other pieces, are supplied at these prices.

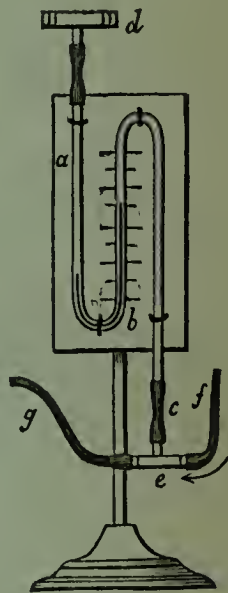
The Miniature Blast Gas Furnaces can all be efficiently worked by the new and cheap Blowing Machines, No. 1166, price 45s, and No. 1167, price 56s. The former, when platinum crucibles are to be used; the latter, when iron is to be fused.

1161. BLAST GAS FURNACE FOR WELDING IRON RODS, say up to half-inch diameter, end to end, so as to make a continuous rod; one of the rods being supposed to be in a fixed position, price £8 8s.

The apparatus consists of a blast furnace, similar to No. 1148 of the preceding list, and of an anvil depressed in the middle and fixed in a solid block of wood. The anvil and furnace are screwed to a solid iron plate, which is furnished with three pair of wheels, and these run upon a pair of iron rails secured to a wooden base. The furnace is made to open and shut like a pair of shears, which are worked by a lever. The railway and carriage are so adjusted, that at the commencement of a process, the end of the fixed iron rod coincides with the centre of the furnace. The end of the additional iron rod is then held in the furnace, and the furnace being closed, the gas is set on and lighted, and the blast is applied. The iron is speedily brought to a welding heat, the lever is then depressed and pulled, by which means the furnace is opened, the carriage runs along the railway, and the anvil is brought exactly under the two red-hot rods, which can then be easily welded by hammering.

BLOWING MACHINES.

1162. The Blast Gas Furnaces, the Gas Blowpipes, and the Oil-lamp Furnaces, require the aid of Blowing Machines sufficiently powerful to supply a constant and uniform blast of air, without which the true power of the furnaces cannot be developed. It is convenient to have these Blowing Machines as compact as possible, and desirable to have them at moderate prices. The following articles fulfil these conditions more or less completely. It is rather difficult to state explicitly what is the power of each machine. I have stated what furnaces each is best suited for, and a comparative view of the force of the blast supplied by several when used under the same circumstances is given in the following table. The trials were made as follows:—The blast of air, passing from a blowing machine to a six-jet blast gas-burner, in the direction marked by the arrow, was made to pass through the tube *f e g* forming part of the pressure-gauge represented by Fig. 1162. The glass tube, *a b c*, contains mercury, which, when at rest, settles at the same level in the two columns *a b*, but when *f* is connected with a blowing machine in action, and *g* with a gas-burner, the mercury descends in the tube *b* and rises in *a*; and the difference of level, indicated by the scale drawn on the board in inches, shows the comparative force of the blast.



1163.

Catalogue No. of the Machine.	Pressure of Mercury.	Catalogue No. of the Machine.	Pressure of Mercury.
1163	2 inch.	1166	1 inch.
1164	2 inch.	1168	$\frac{1}{2}$ inch.
1165	1 inch.	1169	$\frac{1}{2}$ inch.

Any blowing machine which is intended to supply a blast of air that will melt more than two pounds of cast-iron in a gas or oil furnace, must, when tried in this manner, show a pressure exceeding 1 inch of mercury, and must have a steady blast, that is to say, the mercury in the gauge must not vibrate violently.

1162. Price of the Pressure Gauge, Fig. 1162, 6s.

When this gauge is supplied with water coloured blue by sulphate of indigo, instead of with mercury, it serves to indicate the pressure of ordinary coal-gas, which is commonly from $\frac{1}{2}$ inch to 1 inch of water. The T-piece *d* is $\frac{1}{4}$ inch diameter, and the T-piece *e* is $\frac{1}{2}$ inch diameter, the former to suit caoutchouc gas-tubes, and the latter to suit air-tubes. Wherever the pressure of gas varies considerably, it is convenient to have a gauge of this sort always at hand; and when a fusion that demands a very high temperature is to be effected, the trial should be deferred till the gauge shows the gas to be at a sufficient pressure.

1163. Circular Blowing Machine, with spring and weights, as represented in Figure 1163. £4 4s.

This is suitable for Nos. 1, 2, 3, of the Blast Furnaces, but is not powerful enough for No. 4. It serves for the oil-lamp furnaces, the gas blowpipes, and the miniature blast furnaces.

1164. Circular Blowing Machine, of a large and powerful description, being a portion of Deville's Chemical Forge, No. 771. It is cased in iron, £9.

This is powerful enough for the Blast Gas Furnace No. 4, with which it will completely melt $\frac{1}{4}$ cwt. of cast iron. It can be used with the smaller blast gas furnaces, Nos. 1, 2, 3, with *much less labour* than the use of the blower No. 1163 demands. It serves also to feed the larger sizes of Sefstroem's Blast Furnace, Nos. 762—765.

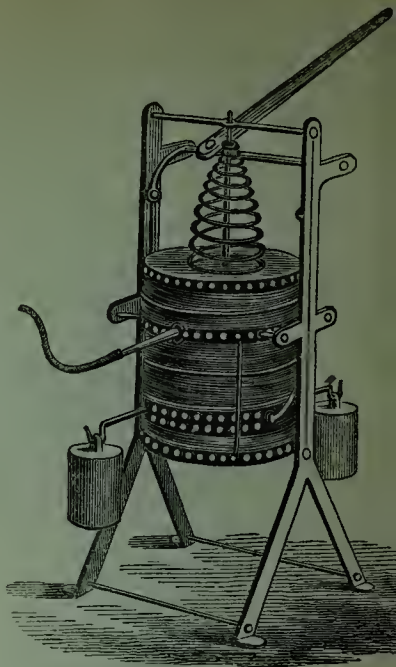
1165. Double Bellows on Frame, form of Fig. 1165. Diameter of Bellows, 14 inches, with strong wooden stool and iron fittings, £3 3s.

This machine is very easy to work, but not so powerful as No. 1163. It can be used with any of the smaller furnaces, but not for Nos. 3 and 4 of the Blast Furnaces.

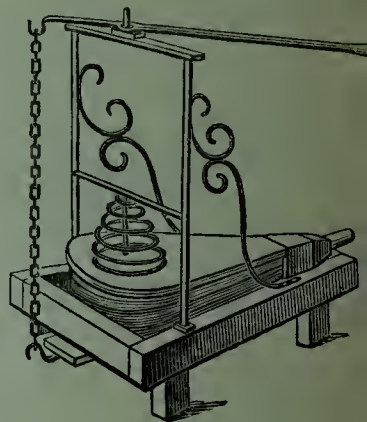
1166. Blowing Machine, consisting of a single bellows, 12 inches diameter, connected with a regulator made of india-rubber cloth, which is pressed by an iron weight, Fig. 1166. £2 5s.

The bellows is contained in the box *A*, and is worked by a long lever, *a*. *B* is the waterproof cloth regulator, which measures 15 inches square by 5 inches deep when distended. *C* is a plate of cast-iron weighing 30 lbs., which slides freely down the round iron rods *d*, and presses uniformly on the bag. The air passes from the bellows into the bag by the tube *b*, in which there is a valve to prevent the return of the air. The air is conveyed to the furnace by the pipe *c*. The power of this apparatus is sufficient to work the miniature blast gas furnaces, No. 1155, and the two smaller sizes of oil-lamp furnaces. The supply of air from this machine is extremely uniform, and well adapted for analytical blowpipe experiments, such as those of Plattner, for a perfectly uniform blowpipe jet can be kept up by it for any length of time by giving an occasional stroke to the bellows, once or twice in five minutes.

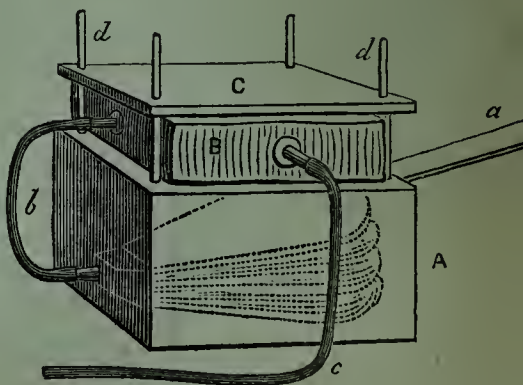
1167. Adaptation of the last-named Blowing Machine, for high temperature £2 16s.



1163.



1165.



1166.

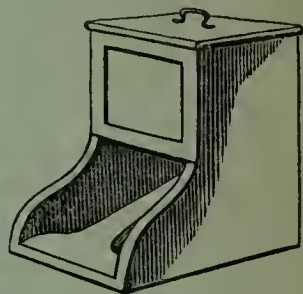
When the Blowing Machine No. 1166 is often required to produce high temperatures, such as is necessary to fuse cast-iron, it is expedient to increase the pressure by using an additional iron plate Fig. 1166. In that case, the pressure is so much increased on the bellows, that it is necessary to change it for one of stronger make. This machine will give air enough to melt 2 lbs. of cast-iron. These alterations raise the price from 45s. to 56s.

68. Modification of Toft's Blowpipe. Zinc reservoir, japanned, measuring 12 inches wide, 18 inches long, 26 inches deep; inclosed in a wooden box, and surmounted with a 12-inch bellows, £3 3s.

In principle this blowing machine resembles that described at No. 217, but it is much larger, and applied with air by the bellows instead of by the mouth. It gives a blast sufficient to melt 1 lb. of cast-iron, and can be used with any of the smaller kinds of blast furnace. But to bring out its greatest power, pretty hard work with the bellows is necessary, in consequence of the pressure of the water. On the other hand, if the blast is to be used to supply a small blowpipe with a single jet; such, for instance, as that used to effect quantitative analyses by the blowpipe, according to Plattner, this apparatus answers extremely well; for, when filled with air, it will give a perfectly steady blowpipe flame for nearly half an hour without touching the bellows; so that any blowpipe operation can be conveniently performed by filling the blower before its commencement, and leaving the bellows untouched to the end of the operation, and the attention of the operator need not be called away from the observation of his experiment.

1169. Blowing Machine, consisting of a double bellows, with a convenient treadle, fixed in a lacquered case, with handle, easily moved about; useful for small operations, £2 2s.

1170. Fanner, with 9-inch Fan, and 29-inch fly-wheel, with treadle, mounted on a frame to screw to the floor, £6 6s.



1169.

This apparatus gives a great mass of air, but the blast has little intensity. It can be used with Sefstroem's furnace, but is not effective with gas furnaces.

1171. Various other Blowing Machines have been described in the preceding pages; for example, that connected with Deville's Chemical Forge, No. 770. Several of the smaller blast furnaces can be worked with the blower of this apparatus; but, as a mere blowing machine, considered apart from its other uses, it is less effective than No. 1163, while it is more expensive.

Some of the instruments for Glass Blowing, described at page 19, could be used as Blowing Machines; but in general the style adopted for mounting bellows that are intended for glass blowing is not that which is most suitable for blowing machines to be used for melting refractory metals. The bellows of No. 211, is the same as that of No. 1165; but the leverage of the treadle of No. 211, is so short in comparison with the leverage of No. 1165, that the power of the former is insignificant when compared with that of the latter. The blowing machines of glass blowing tables can be used for small furnaces or for blowpipes to produce moderate heats, but not for producing very high temperatures. When a blowing machine is chiefly required for furnace operations and only occasionally for glass blowing, it is convenient to have a machine with a long lever, such as Nos. 1163, 1166, or 1167, and to adapt to it a chain and treadle to be worked by the foot. The latter is used only for glass blowing, and is removed when the blower is required for furnace work.

1175. WIND GAUGE, to determine the force of the blast of air, for blast furnaces, the scale on silvered brass, divided into inches and tenths, 4s.

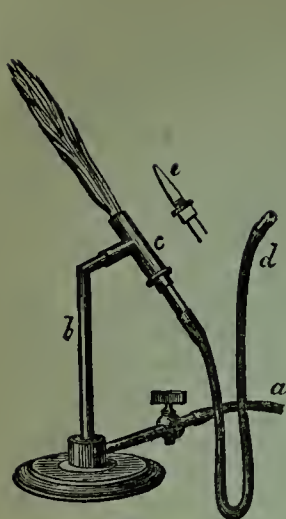
1176. Wind Gauge, the scale on wood, 3s.

1177. Manometer, with brass scale, for steam engines, 4s.

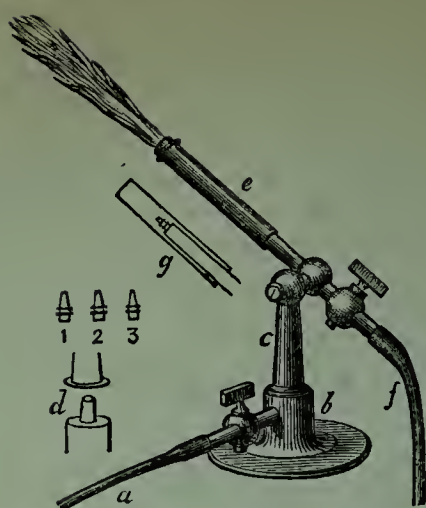
GAS BLOWPIPES.

1180. Herapath's Gas Blowpipe, with a tube, through which air is blown by the mouth into the flame, Fig. 1180, 7s. 6d.

This Blowpipe, invented by Mr. Herapath, sen., of Bristol, was the original gas blowpipe upon which so great a variety of modifications have been founded. *a* is the gas supply pipe, *d* the air tube, *c* a tube in which the gas and air are mixed, *e* the blowpipe jet of the air tube, *b* the support about which the tubes are moveable.



1180.



1181.

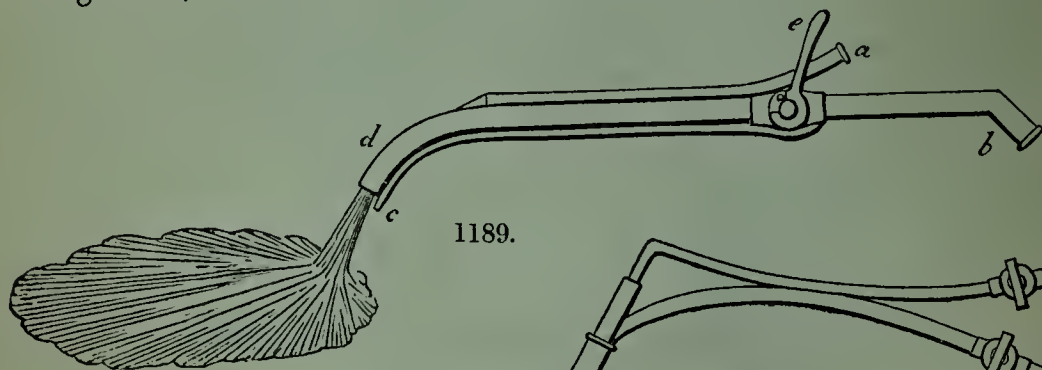
1181. Bunsen's Modification of Herapath's Gas Blowpipe, with two Stopcocks and three Brass Nozzles with different orifices, Fig. 1181, (without the caoutchouc tubes) 15s.

a, b, c, are pipes for the supply of gas; *f* is the tube for the blast of air, for small operations, the mouth may be used, but for heating crucibles, a blowing machine is necessary; *e* is the tube in which the gas and air mix; the relation of the air tube to the external gas tube is shown at *g*; *d* shows the manner of putting on the blowpipe jets, of which there are three sizes, marked 1, 2, 3. At *e*, there is an outer sliding tube, by which the form and volume of the flame can be regulated.

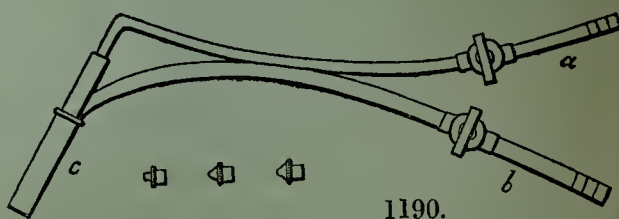
1182. Herapath's Gas Blowpipe, fixed on a stand, with moveable joints, with a vulcanized caoutchouc blowing machine, and a caoutchouc regulator, 40s.

See Fig. 1182; *c* is the blower, *d* the regulator. In practice the blower is pressed by the foot of the operator, the vulcanized caoutchouc tube fixed between *c* and *d* being made sufficiently long to reach from the table to the floor.

1189. BRAZIER'S BLOWPIPE, a Gas-Burner for the use of silversmiths, braziers, &c., Fig. 1189, 24s.



1189.



1190.

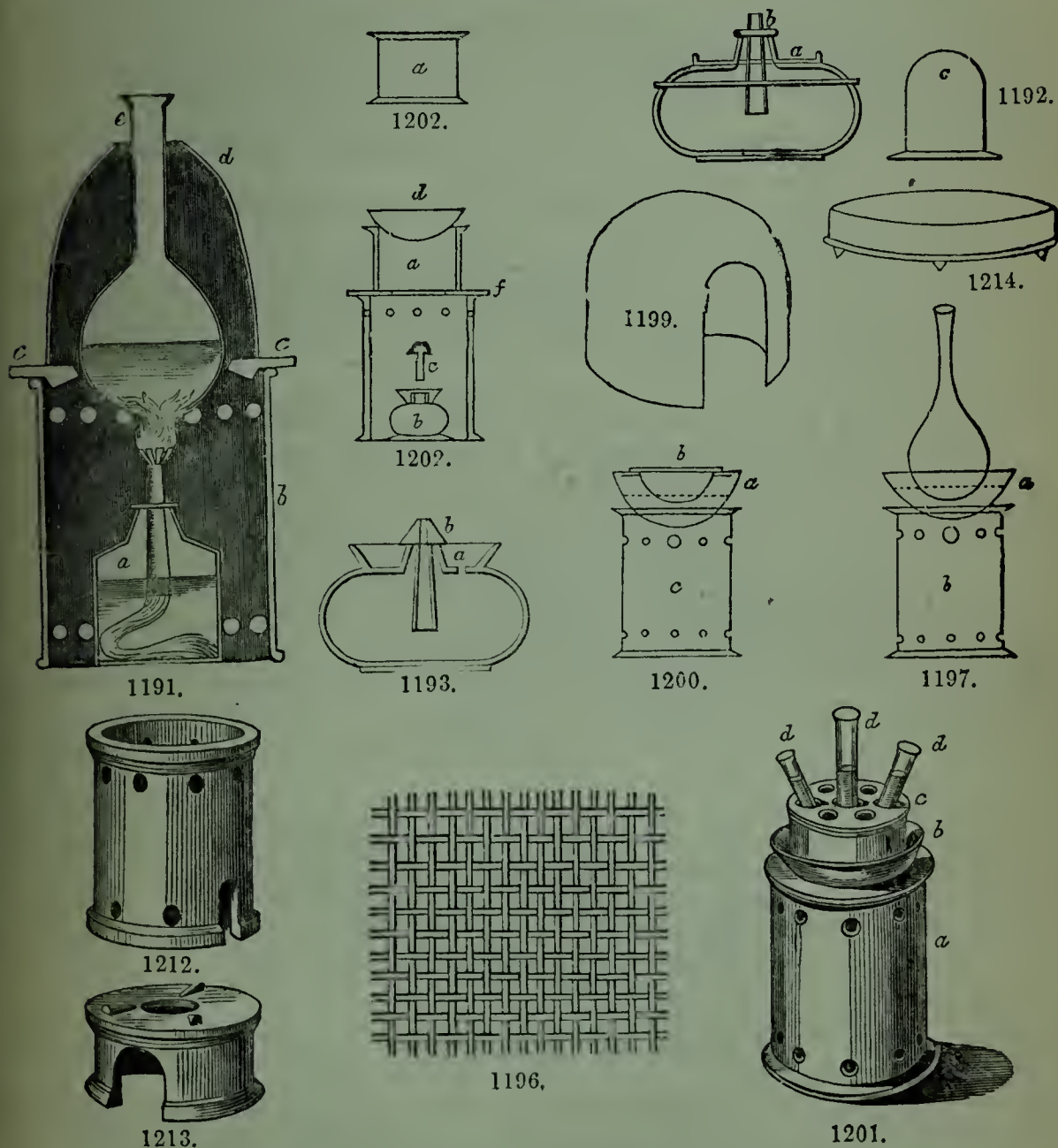
This burner keeps a very small flame constantly alight at *c*, and by means of a flexible pipe a larger jet *d*, is put in connexion with a blowing machine. When required for use, the spring stopcock *e* is opened and the blowing machine set to work, upon which a large spread flame is produced which covers a surface of seven inches in diameter.

1190. GAS BLOWPIPE FOR SOLDERING LEAD PLATES, as in the erection of vitriol chambers, to be used with coal gas and atmospheric air, Fig. 1190, 20s.

The coal gas is supplied by the tube *b*, the atmospheric air by the tube *a*. There are three blowpipe jets, and a sliding outer tube *c*, by which, and the due management of the stopcocks, the gas and air can be mixed in proper proportions for burning. The instrument is held by the hand applied across the double tubes, above the stopcocks.

GAS BLOWPIPES WITH ONE SMALL JET, *suitable for Analytical Experiments on Chemicals and Minerals*, will be described in the section on BLOWPIPE APPARATUS.

GRIFFIN'S LAMP FURNACE.



The Lamp Furnace is useful in Qualitative Analysis and for other experiments with small quantities of materials, and in operations requiring only a moderate degree of heat, such as boiling, digestion, small distillations, &c. It consists of the following articles, most of them made of incorrodible saltglazed stoneware :—

1191. Stoneware Cylinder, with air-holes, intended to steady the flame of the spirit lamp, and to support vessels over it, form of Fig. 1200, and *b*, Fig. 1191, 6 inches high, 4 inches wide, 8d.

Since the introduction of gas burners, the cylinder has been made with a slit at the side for the passage of the gas-pipe. This is shown in Fig. 1212. But a taller cylinder, No. 1210, is better suited than No. 1191 for use with gas burners.

1192. Stoneware Spirit Lamp, with stoneware wickholder *b*, and cap *c*, Fig. 1192, 8d.
 1193. Stoneware Oil Lamp, with stoneware wickholder *b*, and cup *a*, to catch the overflowing oil, useful for slow operations where gas is not procurable, Fig. 1193, 8d.
 1194. Pair of Flat-iron Ring-tops for the cylinder, with perforations for supporting flasks and capsules, used as shown by *c*, Fig. 1191 and *f*, Fig. 1202; *per pair*, 4d.
 1195. Pair of Hot Plates, or flat pieces of iron or tinplate, to support flat-bottomed vessels on the cylinder, 2d.
 1196. Iron Trellis Top, to support vessels on the cylinder, Fig. 1196, 5 inches square, 2d.
 1197. Tinned Iron Sandbath, to fit the top of the cylinder, 5 inches diameter, shown by *b*, Fig. 1201, and by *a*, Fig. 1197, 4d.
 1198. Stoneware Dome to cover a flask while being heated, to economise the heat, shown by *d*, Fig. 1191, 4d.
 1199. Stoneware Dome, to cover small retorts while being heated, Fig. 1199, 4d.
 1200. Stoneware Water Bath, in two pieces, one to hold the water, the other for the substance to be heated, 5 inches diameter, to fit the cylinder, *a*, *b*, Fig. 1200, 8d.
 1201. Stoneware Tube Support, by which glass tubes containing liquids may be kept in an upright position when heated on a sandbath; see Fig. 1201, where *a* is the furnace cylinder, *b* the sandbath, No. 1197, *c* the tube support, with holes for 7 tubes, and *d*, *d*, *d*, test tubes standing in the sand, 6d.
 1202. Set of Four Cylinders, adapted to heighten the lamp cylinder, No. 1191, and adjust vessels at proper heights above the lamp, and thus regulate the heat, *a*, Fig. 1202, all of them 4 inches diameter, and respectively 2, 2½, 3, and 4 inches high; *per set*, 1s. 4d.

For the above in sets, see No. 1218.

ADDITIONAL PIECES FOR GRIFFIN'S LAMP FURNACE, and *Pieces made of Porcelain, or otherwise differing in size or quality from the foregoing.*

1203. The Oil Lamp, Fig. 1193, in white glazed Berlin porcelain, with porcelain wickholder and cover, 1s.
 1204. The Furnace Body, or Cylinder, with air-holes, No. 1191, 6 inches high, 4 inches diameter, but without the slit at the side, Berlin porcelain, 1s. 9d.
 1205. Dome, to cover flasks while being heated, *d*, Fig. 1191, Berlin porcelain, 1s.
 1206. Dome, to cover retorts while being heated, Fig. 1199, Berlin porcelain, 1s.
 1207. The Water Bath, in two pieces, *a*, *b*, Fig. 1200, Berlin porcelain, 2s. 6d.
 1208. The Water Bath, in Wedgwood's porcelain, 1s. 6d.

For other Water Baths, see No. 1236.

1209. Support for Tubes on the Sandbath, 7 holes, *c*, Fig. 1201, in Wedgwood's porcelain, 1s.
 1210. Furnace Body, or Cylinder, with air-holes, saltglazed stoneware, similar to Nos. 1191 and 1212, 4 inches wide, but 8 inches high, with a slit at the side, being intended for use with gas burners, 1s.
 1211. Furnace Cylinder of Saltglazed Stoneware, similar to Fig. 1191, but of larger sizes, being 10 inches high, 7½ inches diameter, and with a slit at the side, 2s. 6d.

1212. Another Cylinder, similar, 10 inches high, 9 inches diameter, Fig. 1212, 3s.
 1213. Saltglazed Stoneware Foot, Fig. 1213, intended to raise the cylinders to a proper height above lamps or gas burners, 9 inches diameter, $4\frac{1}{2}$ inches high, Fig. 1213, 2s.

At No. 911, a special use for this Foot is pointed out.

1214. Glazed Earthenware Pan, to place below the lamp furnace when in action, form of Fig. 1214, 9 inches diameter, 1s. 2d.
 1215. The Sandbath No. 1197, may be had in several varieties. See article on Sandbaths and Drying Apparatus, No. 1225.
 1216. Tin-plate Still, pint size, in one piece, for distilling water, 1s. 6d.
 1217. Ditto, with loose head and sieve, 2s.

GRIFFIN'S LAMP FURNACE, IN SETS.

1218. THE ORIGINAL STONEWARE LAMP FURNACE SET, comprising the 17 articles from No. 1191 to No. 1202, price 6s.
 1219. The same with a Glass Spirit Lamp, instead of a Stoneware Spirit Lamp, 6s. 6d.
 1220. A SET TO USE WITH GAS, namely, the same as above, with a tall cylinder, No. 1210, and a Rose Gas Burner, No. 973, but omitting the Spirit Lamp, No. 1192, the Oil Lamp, No. 1193, and the four Cylinders, No. 1202, which are not required with a gas burner, 6s.
 1221. THE PORCELAIN SET, comprising the articles Nos. 1194, 1195, 1196, 1197, 1203, 1204, 1205, 1206, 1207, 1209, with a Glass Spirit Lamp, No. 852, *the set*, 10s. 6d.

BATHS FOR APPLYING HEAT.

A. SAND-BATHS.

Sandbaths have been described in several instances as forming portions of particular furnaces.—See Nos. 745, 747, and 772. In the present section, only such portable sandbaths will be noticed as can be readily used over any moveable source of heat, such as that of a gas furnace.

Digesting Flasks, Beaker Glasses, &c., which are apt to split when exposed to the direct flame of a lamp, are protected from that accident when a thin stratum of sand is put between the flame and the flask.

1225. SAND BATHS, polished metal, form of *a*, Fig. 1197, or of *b*, Fig. 1201, adapted for Griffin's Lamp Furnace, See No. 1197, or for the rings of a Retort Stand, Fig. 874 *n*.

- | | |
|---|--|
| No. 1. Copper, 5 inches diameter, 8d. | No. 3. Copper, $3\frac{1}{2}$ inches diameter, 5d. |
| 2. Tin-plate, 5 „ 4d. | 4. Tin-plate, $3\frac{1}{2}$ „ 3d. |
| 5. Deep form of Tin-plate sand-bath, 5 inches diameter, 6d. | |

1226. Cast Iron Pots, with round bottom, for sand-baths or water-baths, form of Fig. 1226, with two handles and three legs.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	7-inch.	$\frac{1}{2}$ gallon.	9d.	3.	9-inch	1 gallon.	1s. 3d.
2.	8 „	$\frac{3}{4}$ „	1s.	4.	10 „	$1\frac{1}{2}$ „	1s. 9d.

1227. Shallow Cast-iron Pans, with flat bottom, for water-baths or sand-baths, form of Fig. 1227, with two handles and flat iron covers.

- | | |
|--|---|
| No. 1. 9 inches wide, $4\frac{1}{2}$ inch. deep, 1s. 6d. | No. 2. 10 inches wide, $4\frac{1}{2}$ inch. deep, 2s. |
| No. 3. 12 inches wide, 5 inches deep, 2s. 6d. | |



1226.



1227.



1228.

1228. Thin Cast-iron Sand-baths, with round bottom, as represented by Fig. 1228, with two handles:

6-inch	8d.	10-inch,	1s.	13-inch,	1s. 9d.
7-inch	8d.	10 $\frac{3}{4}$ -inch,	1s. 2d.	13 $\frac{1}{2}$ -inch,	2s.
8-inch	8d.	11 $\frac{1}{2}$ -inch,	1s. 4d.	14-inch,	2s. 4d.
9-inch	9d.	12-inch,	1s. 6d.	15-inch,	2s. 8d.
9 $\frac{1}{2}$ -inch	10d.				

B. WATER AND STEAM BATHS.

1231. Water Bath, tin-plate, pan shape, with handle, provided with a set of rings to adapt the opening to basins of different sizes:

No. 1. Tin Bath 5 $\frac{1}{2}$ -inch, with set of 3 rings. 3s.

2. Tin Bath 7-inch, with set of 5 rings. 5s.

1232. Water Bath, thin cast-iron, tinned inside, with handles, Fig. 1232:—

No. 0. Contents 6 pints, 6 $\frac{1}{2}$ inches deep, 8 inches wide at top, 2s. 6d.

2. „ 8 „ 7 „ 9 „ 3s.

Other sizes of this form of Water Bath can be supplied up to 13 gallons contents.

1233. Water Bath, Hemispherical, thin cast-iron, lined with glazed earthenware, with flange about an inch broad, Fig. 1233:—

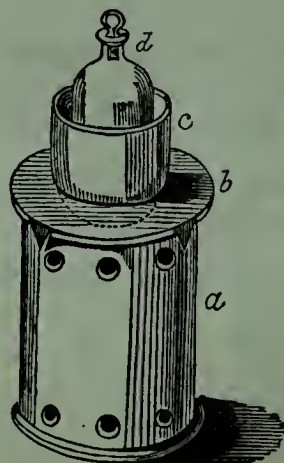
	Inside Diameter.	Depth.	To fit holes	Price.
No. 1	8 inches	4 inches	8 $\frac{1}{2}$ -inch	4s.
3	9 $\frac{1}{2}$ „	5 „	10 „	5s.
4 a	11 „	5 $\frac{1}{2}$ „	12 „	7s. 6d.

The above can be provided with tinplate or copper covers, with holes to fit basins of any specified size.

Similar Water Baths can be supplied up to 20 inches diameter.



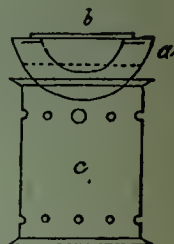
1232.



1235.



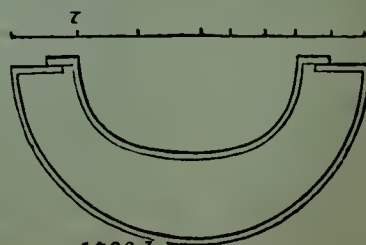
1236 a.



1236 c.



1233.



1236 b.

1234. Water Bath for Bottles or other upright vessels, form of *c*, Fig. 1235, of glazed Dresden porcelain, 4 inches wide, 4 inches deep, 1s. 3d.
1235. The same Water Bath, with a saltglazed stoneware cylinder, 8 inches high, suitable for heating with gas, with metal top, Fig. 1235, 2s. 6d.

This apparatus is very handy when a solution that contains a precipitate requires to be heated, as in the precipitation of silver with chloride of sodium.

WATER BATHS, FOR DRYING POWDERS, &c. at a *steam heat*.

Water Bath, consisting of an outer boiler, and an inner capsule, shown by Figs. 1236, *a*, the boiler, *b*, the capsule, *c*, a lamp furnace.

No.	Diameter of Boiler.	Contents of the Capsule.	Material.	Price.
1236.	4½ inches,	3 ounces,	Saltglazed Stoneware,	8d.
1237.	4½ inches,	3 ounces,	Wedgwood's Porcelain,	1s. 3d.
1238.	5 inches,	4½ ounces,	Ditto,	1s. 6d.
1239.	4½ inches,	3 ounces,	Berlin Porcelain,	2s. 3d.
1240.	5 inches,	4½ ounces,	Ditto,	2s. 6d.
1241.	5½ inches,	6 ounces,	Ditto,	4s. 6d.
1242.	3½ inches,	3 ounces,	Thuringian Porcelain,	2s. 3d.
1243.	4½ inches,	4 ounces,	Ditto,	3s.
1244.	6 inches,	8 ounces,	Ditto,	4s.

Copper Water Bath, hemispherical, suitable for a retort-stand ring or a furnace top, with set of rings for small basins, Fig. 1248.

1248. 6-inch Bath, with 4 rings, 7s.

1249. 7-inch Bath, with 4 rings, 11s.

1250. 8-inch Bath, with 5 rings, 14s.

1251. 9-inch Bath, with 6 rings, 18s.

1252. Copper Water Bath, 7 inch diameter, with 4 rings, with Fresenius's contrivance for keeping the water at a constant level. Represented by Fig. 1252. This consists of a glass fountain bottle, of about 3 pints capacity, mounted in a zinc case, and connected with the water bath by a copper tube. Price, without the tripod and table support, 18s.



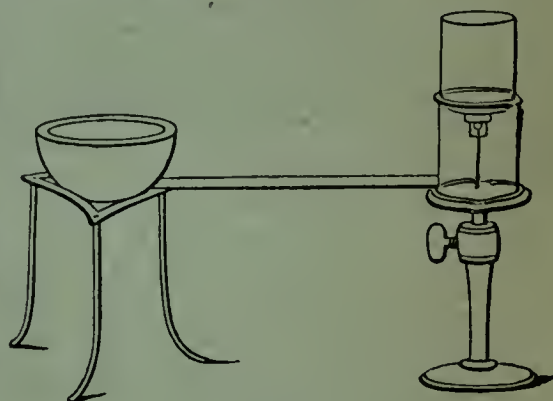
1248.

The other articles represented in Fig. 1252 are the tripod, No. 297, price 1s. 3d., and the mahogany table, No. 331, price 4s. Instead of the table, the block supports, No. 393, price 1s. 3d., may be used.

1254. Water Bath, combined with arrangement for filtration at 212° Fahr.

a. The bath made of japanned tin-plate. £2.

b. The bath made of polished copper, £4 10s.



1252.

The form of this apparatus is shown by Fig. 1254. It consists of a rectangular boiler, measuring 20 inches in length, 16 inches in width, and 5 inches in depth. It is mounted on iron legs, 10 inches high, which adapt it for use with the rose gas-burner, No. 2 (974), with which burner, but without the rose, 3 gallons of water, which half fills the boiler, can be kept in ebullition. The side walls of the boiler descend one inch all round, to form a curtain to retain the hot air under the bottom of the boiler. There is a conical hole in which a funnel of from 5 to 7 inches in diameter can be heated, for filtrations at 212°. There are six openings measuring 1, 2, 4, 5, 6, and 8 inches in diameter for evaporating basins, with upright collars for supporting the basins, and a cover for each opening that is not in use. There are three rings for diminishing the size of the 8-inch opening, similar to the rings of the bath, No. 1248.



1254.



1255.

1255. Water Bath, combined with arrangement for filtration at 212° Fahr. Smaller size than the preceding, 12s.

This apparatus is represented by Fig. 1255. It is made of japanned tin-plate. Size, $11\frac{1}{2}$ inches long, 5 inches wide, 4 inches deep. It has a conical space for a 5-inch funnel of 60° , a 5-inch opening for an evaporating basin, a $3\frac{1}{2}$ -inch ring for a basin, adapted to the 5-inch opening, two openings for boiling tubes, and covers to close the openings. Mounted on iron legs of suitable height for the rose burner, No. 2 (974), to be placed below to boil the water.

C. GAS BATHS, FOR REGULATED TEMPERATURES.

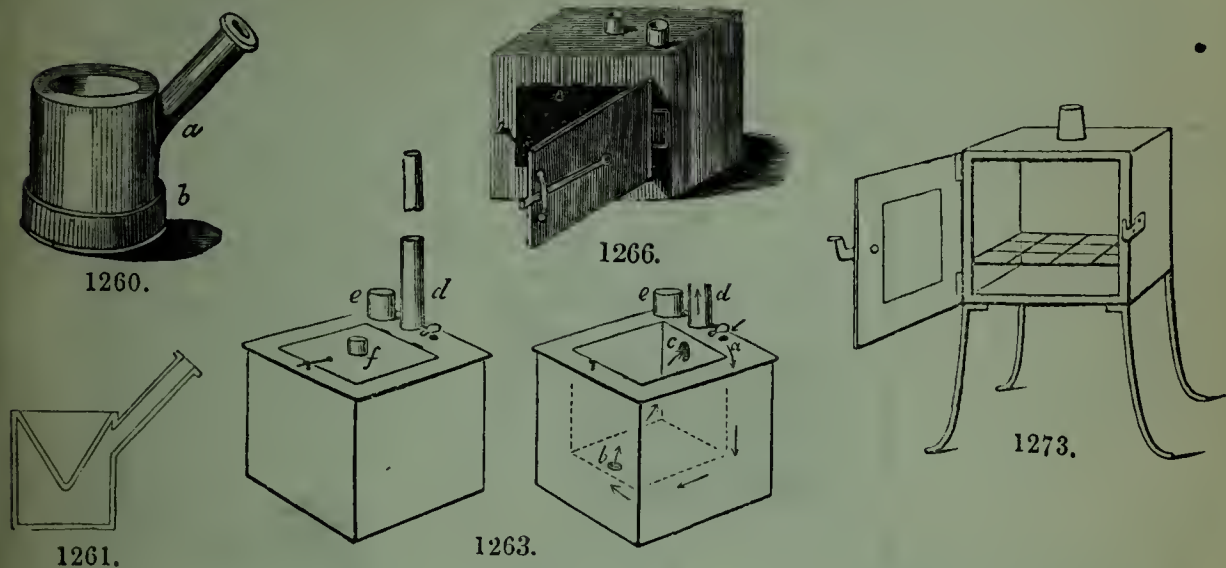
1259. The Bunsen's Gas Burners, No. 945, and the Rose Burners, No. 973, afford the means, when regulated as described at No. 1013, of producing a long-continued determinate heat. But to use that heat, it is necessary to place over the burner a proper chamber to enclose the hot air, and the substance to be exposed to it, thus cutting off the action of the atmosphere and loss of heat by radiation. If the apparatus is to be sustained at a given heat for a period too long to be continually watched, the supply of gas must be regulated by Bunsen's thermostat, No. 1274. It must be recollected that all objects that are exposed to the heat that rises directly from a gas-burner, sustain also the action of the vapour of water, and the carbonic acid gas, which accompany the heated air, so that such an arrangement is to be distinguished from the *Drying Baths* described in the next subdivision. The size and material of the chamber for confining the heat, must depend upon the object that is to be heated. The chamber may be, for example, a cylinder of clay, or a box of wood. Suppose you wish to heat a long glass tube for a considerable time at a given temperature between 100° and 600° Fahr., you may use a gas tube furnace, such as No. 1078, removing the brick, and placing on the iron frame an oblong box of dry wood, open at the top and the bottom, and having, if necessary, glass sides or windows. Between the iron frame and this box must be placed 4 or 5 layers of fine iron-wire gauze. By a proper regulation of the gas jets, and a due thickness of wire gauze, it is not difficult to produce in this manner a pretty uniform atmosphere of any desired temperature under 600° Fahr., and to keep it within a few degrees of the required point. This may also, by using a fire-clay cylinder, and a proper arrangement of gas jets, a large included space can be brought easily up to a heat of 400° or 500° ; and this kind of apparatus may be usefully employed in many technical operations.

D. AIR DRYING BATHS, HEATED BY WATER OR OIL.

1260. Water Bath (or Oil Bath), consisting of a boiler and capsule, in one piece of porcelain, with a pipe to carry away the steam when water is used, Fig. 1260. The capsule is made conical, as shown in section by Fig. 1260, in order to fit a wet filter transferred with a precipitate from a filtering funnel of 60° . Height of the bath, $4\frac{1}{2}$ inches; diameter of funnel 4 inches, 2s.

1262. Tin Sand Bath, to spread the heat uniformly over the bottom of the water bath, *b*, Fig. 1260, 6d.

1263. Griffin's Hot-water Bath, by which substances can be rapidly dried in a current of air at 212° F. Copper double bath, the joints hammered close and soldered, with door at the top. Inside measurement 5 by 6 inches, by 6 inches deep; outside, 7 by 7 inches by $7\frac{1}{2}$ inches deep, with perforated shelf and a chimney, to draw air through the Bath, 25s.



1264. Griffin's Hot-water Bath, larger size; inside 7 by 7 inches by $7\frac{1}{2}$ inches deep, outside 9 by 9 inches, by 9 inches deep, 42s.

1265. Thermometer suitable for this bath, showing 330° F., with paper scale, enclosed in glass, 3s.

The air enters by the orifice *a*, and is carried through the hot water in the direction of the arrows by an air tube not shown in the figure. The air thus heated, goes into the drying chamber at *b*, and escapes by the orifice *c*, into the chimney *d*, upon which two extra tubes can be placed to increase the draught. When the casing contains water only, a temperature of 212° F. is easily sustained, and the change of air causes the desiccation to proceed rapidly. A moveable shelf, not shown in the figure, is placed across the middle of the chamber. The tube *c*, admits a thermometer into the water. The tube *f*, communicates with the hot chamber.

1266. Copper Water Bath intended for drying substances for organic analysis, &c., by means of heated water, as used in the laboratories of Liebig, Rose, &c., made of strong copper plates, the joints hammered close and soldered, Fig. 1266; size of hot chamber 7 inches square; size of the apparatus, 9 inches square. One of the upper openings is for taking the temperature of the oil, the other for ascertaining the degree of heat in the chamber, 42s.

1267. Copper Water Bath, smaller size, same pattern as Fig. 1266; size of the hot chamber, 5 by 6 inches, and 6 inches deep; outside measurement, 7 by 7 inches by $7\frac{1}{2}$ inches deep, 25s.

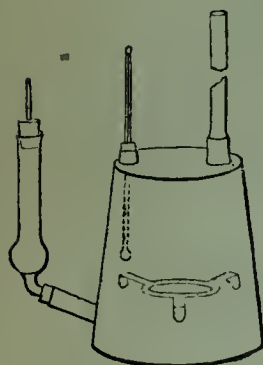
The baths of the form of Fig. 1266 are handier in use than those of the form of Fig. 1263; but the latter gain the highest temperature, dry the quickest, and can be most effectually regulated.

1268. Copper Oil Bath, form of Fig. 1266, thick metal, brazed joints, outside measure, 6 inches wide, 5 inches high, 5 inches from front to back; size of hot chamber, 4 inches wide, 3 inches high, $3\frac{1}{2}$ inches from front to back, 24s.

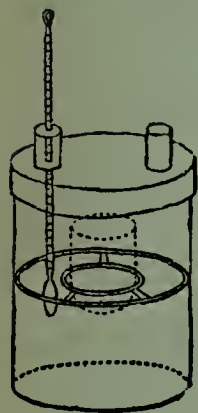
1269. Copper Oil Bath, thick metal, brazed and riveted; size of hot chamber, 7 inches square, 6 inches high; outside measurement of the bath, 9 inches square, 8 inches high, 56s.

E. AIR DRYING BATHS, WITHOUT WATER OR OIL

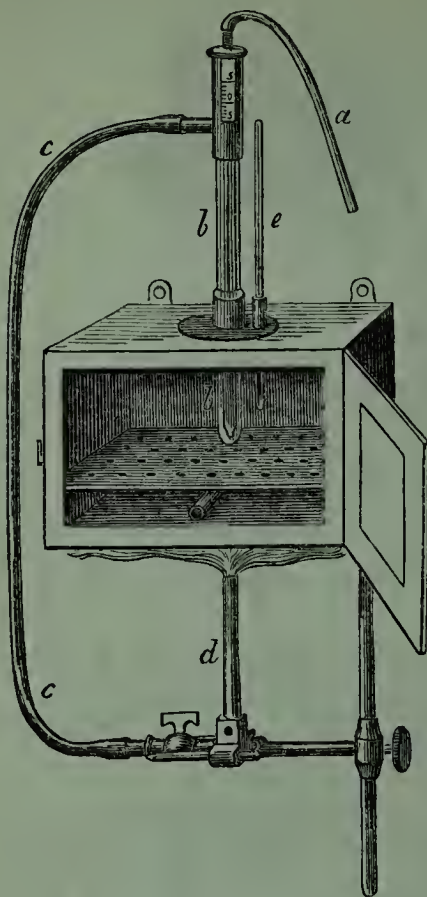
1273. Fresenius's Copper-air Bath, with trellis shelf, and door in front; mounted on iron legs; size of the warm chamber, 6 inches wide, 5 inches high, $4\frac{1}{2}$ inches from front to back, Fig. 1273, page 129, 21s.



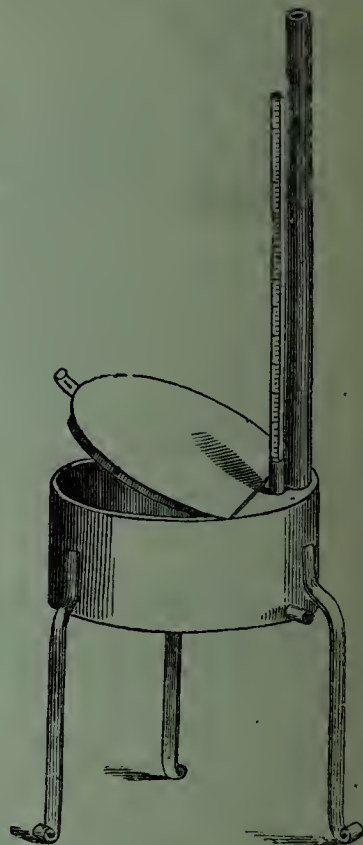
1278.



1276.



1274.



1279.

1274. Bunsen's Hot-air Bath, with modification of Kemp's regulator, to cause the supply of gas to produce a constant temperature. Copper bath, with hooks to hang it to a wall; size of hot room, 7 inches wide, $4\frac{3}{4}$ inches high, 5 inches from front to back. Price, with Regulator for the flow of gas, but without thermometer and gas burner, Fig. 1274, 25s.

1274. *a*. The Regulator without the bath, 6s.

The regulation of the temperature is effected by increasing or diminishing the supply of gas to the burner *d*. This is managed by the action of the apparatus marked *a*, *b*, *c*. The gas enters by *a*, passes into a narrow tube which is continued for about two-thirds of the length of *b*, and is open at the lower end. The gas escapes there and passes out by the tube *c* to supply the burner *d*. The lower part of the tube *b* contains mercury, and in that mercury is fixed a small glass tube that is closed at the upper end and has a small hole at the lower end. This tube is partly filled with air and partly with mercury. There is a scale and a screw at the upper end of the tube *b*, by which the proper supply of gas can be regulated at the commencement of a process. Supposing the apparatus to be in action, as represented by the Figure, if the heat becomes greater than is required, the air in the enclosed glass vessel expands and drives out the mercury, which rises in the tube *b*, and closes the lower end of the continuation of the supply pipe *a*. But, in order to prevent the extinction of the flame at *d*, the inner supply pipe is either pierced with a small hole which remains always open, or the lower part of the tube is provided with fine slits which permit a slight passage of gas when the bottom is closed. When the heat falls in the bath, the air enclosed in the tube *b* condenses, the mercury falls, and a greater supply of gas is admitted to the burner.

1276. Rammelsberg's Hot-air Bath, form of Fig. 1276, made of copper. The substance to be dried is put in a crucible, and fixed in the centre of the bath. The apparatus is set over a spirit lamp, or gas light, and one or two thermometers are introduced through the necks in the lid to ascertain the temperature.
1276. 4 inches high, $3\frac{1}{2}$ inches wide, 8s. 1277. 5 inches high, $3\frac{1}{2}$ inches wide, 10s
1278. Rammelsberg's Hot-air Bath, made of brass, with a neck at which a chloride of calcium tube may be attached for securing a current of dry air through the bath, 4 inches high, 4 inches wide, conical form, Fig. 1278, 7s. 6d.
1279. Taylor's Hot-air Bath, for drying powders, &c., in a current of hot air, to any temperature up to 360° F.; form of Fig. 1279, circular chamber, $3\frac{1}{2}$ inches deep and $8\frac{1}{2}$ inches diameter.
1279. Japanned Tin-plate, 15s. 1280. Copper, 50s.
1281. GRIFFIN'S HOT-AIR BATH, for drying substances in a rapid current of hot air, kept within a few degrees of any desired temperature up to 500° Fahr. Form of Fig. 1281.

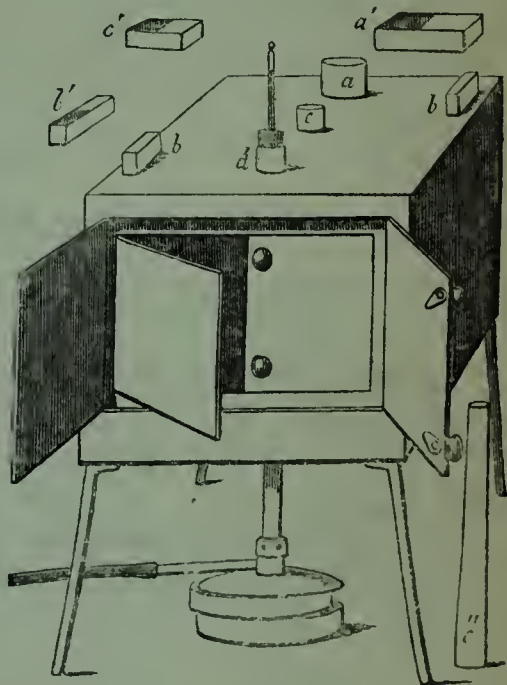
Price, without Thermometer and Gas Burner, £3.

This apparatus consists of a Copper Chamber, measuring 12 inches from left to right, 9 inches from top to bottom, and 8 inches from front to back. This Chamber is enclosed in a Case made of stout sheet iron, which measures 14 inches from left to right, 12 inches from top to bottom, and 11 inches from front to back. There is, consequently, a clear space of at least an inch all round between the copper chamber and the iron case. Hot-air rising from a rose gas burner is made to pass continuously through this space, while a rapid current of heated atmospheric air is made to pass through the copper chamber containing the objects that are to be dried. The arrangement for carrying out his plan is as follows:—

Production and Regulation of the Heat.—The bottom of the iron case has a round hole in the middle rather wider than the head of the Rose gas burner, No. 2 (974). This burner being lighted and applied there, air rushes up through the flame into the space between the copper chamber and the iron case, and passes out by a chimney at the top, marked *a* in the Figure. If it is desired to diminish the draught, the cap *a'* is put upon the neck *a*. This cap has an oblong form. When pulled to the right, it opens the chimney *a* entirely. When pushed to the left, it closes it more or less as may be desired. Attention to this chimney must be combined with due attention to the burner. The latter can be fully or only partially supplied with gas, and it may be pushed up close to the copper chamber, or be lowered two or three inches from it, the clay plates shown in Fig. 1281, being used to regulate the height of the burner.

A ledge or partition of copper runs along the front lower edge of the copper chamber, and closes the space between that chamber and the iron case. A similar ledge runs along the back upper edge of the copper chamber. The former is intended to prevent the rising of the flame from the gas burner into the copper chamber when the front doors are opened; the latter serves to prevent the flame passing directly upon the gas burner up the back of the chamber and out at the chimney *a*. The effect of these obstructions is to force the hot-air to rise up on each side of the chamber, and to pass over the top, to make its way to the chimney *a*. On applying a chimney such as *c''* to the neck *a*, and removing the flame, the whole apparatus is rapidly cooled.

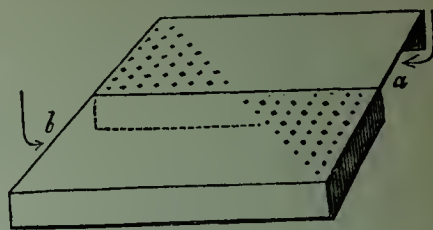
Circulation of Hot-Air through the Copper Chamber.—The copper chamber has a false bottom, which is divided into two compartments, as shown by Fig. 1282. It is a sort of shelf or stool that is about an inch above the solid bottom of the chamber. Each half of the space included between the true and false bottom is open at one end and closed at the other, and the surface is perforated in the manner shown by the Figure. Air passes into the enclosed spaces by two flat copper tubes, the upper ends of which are marked *b b* in Fig. 1281, and the lower ends of which communicate with the open ends of the spaces marked by arrows in Fig. 1282. These air tubes are fixed in the space between the copper chamber and the iron case, and being exposed to the hot air that rises from the gas burner, while the flame of the burner acts directly upon the solid bottom of the chamber, the air supplied by these tubes becomes rapidly and strongly heated, and is delivered



1281.

in that condition through the holes in Fig. 1282, into the hot chamber, from which it escapes by the two openings *c d*, after passing over the objects that are placed in the chamber.

Regulation of the Current of Air.—When a strong current of air is required, the tubes *b b* are both left open, and the chimney *c'* is placed upon the neck *c*. When less air is required, the chimney *c'* is taken off, or is replaced by the oblong cap *c'*, by which the chimney *c* can either be entirely obstructed or opened to any desired degree. The draught of air into the chamber can also be regulated by two caps of the form of *b'*, which are adapted to the openings *b b*, and can open or shut the passage to any necessary degree by merely sliding along them. The neck *d* can be closed by a cap, or it can be used for the insertion of a thermometer to indicate the temperature of the hot chamber. The four pipes, *b, b, c, d*, shown in Fig. 1281, are all in communication with the copper chamber, and pass through holes in the top of the iron case. The chimney *a* alone communicates with the space between the two chambers.



1282

This construction of the apparatus enables the operator, by attention to the gas burner and the chimney *a, a'*, to regulate the amount of heat applied, and by attention to the ventilators, *b, b'*, and *c, c', c''*, to regulate the circulation of air through the drying chamber.

For operations that do not demand a drying heat beyond 300° Fahr., the small rose gas burner, No. 973, is sufficiently powerful; but when a higher temperature is required, and especially when a large quantity of air is to be forced through the chamber, the rose burner, No. 974, is requisite.

The Iron Case and the Copper Chamber are separately opened, by double doors, in front, as represented in Fig. 1281. The copper chamber contains two moveable stools, to sustain capsules, crucibles, &c.

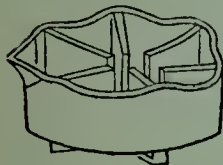
F. APPARATUS FOR DRYING POWDERS IN A VACUUM.

LESLIE'S APPARATUS FOR FREEZING WATER, DESICCATORS, &c.

The articles in this subdivision do not properly belong to the section on the Application of Heat; but they are placed here because it is convenient to have in one group an account of the different methods employed to dry powders at a definite temperature. Apparatus used in the drying of gases will be described in the section respecting Gas Apparatus.

1285. DESICCATING PAN, to contain sulphuric acid, for drying substances in vacuo, or under a glass receiver; with numerous partitions and indented edges for the ready support of capsules, Fig. 1285.

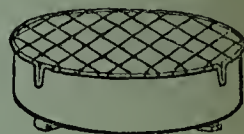
No. 1.	Berlin Porcelain,	4½ inch diameter,	6 Partitions.	3s. 6d.
2.	Dresden Porcelain,	4 "	3 "	2s. 6d.
3.	"	5 "	3 "	3s.
4.	"	5 "	6 "	4s.
5.	Thuringian Porcelain,	4½ "	6 "	3s. 6d.
6.	"	5½ "	6 "	4s.
7.	"	6 "	6 "	4s. 6d.



1285.



1286.



1287.

1286. Desiccating Pan, of Saltglazed Stoneware, to contain sulphuric acid for drying substances in vacuo, cylindrical form, flat bottom, Figs. 1286, 1287, two inches deep:—

6 inches diameter, 1s. | 8 inches, 1s. 3d. | 10 inches, 1s. 6d.

1287. Brass Trellis Tops for the stoneware pans, to support vessels over the sulphuric acid, Fig. 1287:—

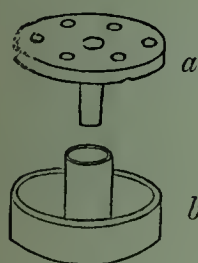
6-inch, 1s. 6d. | 8-inch 1s. 9d. | 10-inch, 2s.

1288. Desiccating Pan, to contain sulphuric acid, for drying substances in vacuo, form of *b*, Fig. 1288; white Berlin semi-porcelain, glazed; three sizes:—

4½-inch, 1s. 6d. | 5-inch, 1s. 9d. | 6-inch, 2s.

1289. Perforated Wood Table, *a*, Fig. 1288, adapted to the pan No. 1288, and suited to support either funnels or capsules, see Fig. 1294:—

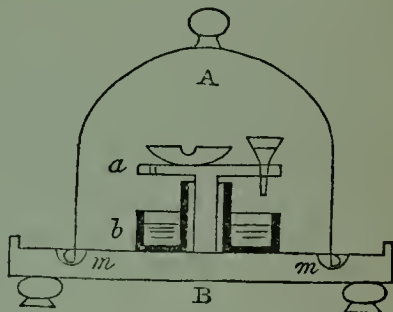
5 inches diameter, 1s. 6d. | 6 inches, 1s. 9d. | 8 inches, 2s.



1288.



1291.



1294.

BELL-SHAPED GLASS RECEIVERS, with stout edges, well ground, suitable for these experiments. See No. 655.

1290. LESLIE'S APPARATUS FOR FREEZING WATER over oil of vitriol in vacuo, consisting of a flat bell-shaped receiver for the air-pump, a porcelain pan for the acid, and a glass capsule for the water. There should be half-an-inch in depth of the strongest oil of vitriol. The pump must be well screwed up, and the receiver greased to fit close. Price of a set to suit Tate's Air Pump, No. 648, 7s.

1291. POROUS CLAY EVAPORATING BASINS, for holding Water over Sulphuric Acid in vacuo, in order to be converted into Ice, form of Fig. 1291:—

4-inch, 6d. | 5-inch, 8d. | 6-inch, 10d. | 8-inch, 1s.

1292. In using this Desiccating Apparatus, the acid pan, half full of concentrated sulphuric acid, is placed on the plate of an air pump, or on one of the separate plates described at No. 687, and being covered with a flat glass receiver, such as No. 655, the air-pump is set in action, and the receiver is exhausted. The stopcock is then closed, and the apparatus allowed to rest till the required effect is produced. The entire apparatus is represented by Fig. 650.

1293. LESLIE'S ORIGINAL APPARATUS for the Freezing of Water (see article COLD in the 'Encyclopædia Britannica') consisted of a powerful air-pump with single vertical barrel, connected with a large wooden table on which were fixed six pump-plates, connected separately by pipes and top-cocks with the pump. That was a very expensive and cumbrous form of apparatus. The production of several portions of ice, each over a separate pan of sulphuric acid, can be much more conveniently effected by using a series of separate tables, such as are described at No. 687, each of them fitted with a flat glass receiver, an acid pan, and a porous water dish of the kind that have just been described; the size of these parts being chosen to suit the power of the pump and the required quantity of ice. The choice of the pump depends upon the principles explained at paragraph 653. The glass receiver should be no larger than barely to cover the vessels that contain the acid and the water. A larger capacity is injurious. In a room at the temperature of 62° F., half a pound of water can be readily frozen in this apparatus, with the aid of the pump No. 653.

When the freezing of water by the air-pump is to be shown as a Class Experiment, the acid should be concentrated, and the pump, the acid, and the water, all be kept as cold as possible. See page 61.

1294. DESICCATION IN CONFINED AIR.

Desiccating Apparatus, for drying powders and crystals, and condensing aqueous solutions, by the action of sulphuric acid, confined in a limited quantity of air under a glass receiver without the use of an air-pump, Fig. 1294. This apparatus consists of a glass receiver *A*, or of a japanned uplate dome of the same form, the rim of which dips into a circular groove *m m*, turned in a wooden base, *b*, and which contains either mercury or oil. The acid pan *b*, and the perforated table *a*, have been already explained at Nos. 1288 and 1289. This was an apparatus used by Berzelius, and the Figure exhibits the process clearly; but the wooden base is now advantageously replaced by a ground glass plate, as described in the next article.

1295. SOLID SQUARE GLASS PLATES, $\frac{1}{4}$ -inch thick, ground upon the upper surface, so that glass receivers ground and greased on the edge, fit them air-tight. These are used with acid pans and glass receivers in the manner represented by Fig. 1294, and with every form of acid pan from No. 1285 to No. 1288. The plates are SQUARE, and the price is according to the diameter:—

7-inch, 1s. 6d.	10-inch, 3s.	12-inch, 4s. 6d.
8-inch, 2s.	11-inch, 3s. 6d.	14-inch, 6s.
9-inch, 2s. 6d.		

GLASS RECEIVERS. See No. 655.

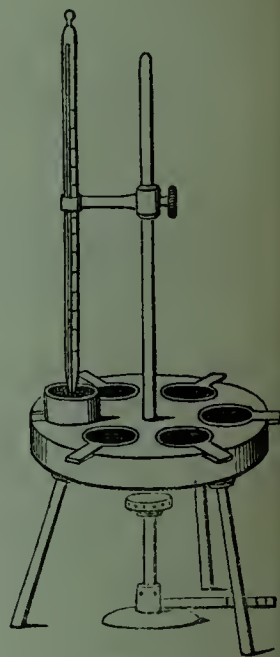
1296. EXSICCATOR, a Divided Glass Vessel, for drying substances in a confined atmosphere over sulphuric acid, or for cooling crucibles before weighing, Fig. 1296. The vessels are of Bohemian glass, with ground and polished edges that fit together in the middle; where a pierced metal diaphragm fits on the lower vessel; 6 inches high, 4 inches diameter, 4s. 6d.

1297. FRESSENIUS'S DRYING DISC, for drying five powders at a time, at the same given temperature, Fig. 1297, 63s.

This apparatus consists of a flat circular block of iron, which measures 8 inches in diameter, and 2 inches in thickness, and weighs about 19 lbs. It is turned smooth and provided with 6 cavities, similar in size and at equal distances from the centre. In one of these cavities a thermometer is bedded in iron filings, and the other five cavities are exactly filled by five turned brass pans, which are 2 inches in diameter, and $\frac{3}{4}$ inch deep, to contain the substances which are to be dried. The heat is applied below the centre of the iron block. The apparatus is used by Fresenius in drying manganese ores for analysis, and is useful when many samples require to be rapidly dried at the same temperature.



1296.



1297.

1298. SCHRÖTTER'S DESICCATOR, for cooling substances in dry atmospheric air at ordinary atmospheric pressure.

1298. Price of the apparatus Fig. 1298 *b, d, e, f, g*, without the plate *a*, and the acid pan *c*, but with a receiver 7 inches wide and $7\frac{1}{4}$ inches high, 9s.

1299. Price of a plain ground glass plate for it, size 8 inches square, 2s.

1300. Price of the tube *d, e, f*, unfitted, 2s. 6d.

For other sizes of Receivers and Ground Plates, see Nos. 672 and 1295.

Description.—*a* is a separate air-pump plate, No. 687. Instead of this, a plain square ground glass plate unmounted, No. 1295, may be used; *b* is an air-pump receiver, No. 672; *c*, a divided porcelain dish, to contain sulphuric acid, No. 1285, upon the divisions of which the warm crucible is placed; *d, e, f*, a combination of 3 glass tubes; *g*, a small chloride of calcium tube; *h*, a glass tube affixed to the cork *i*, below the point of the tube *d*. A small quantity of sulphuric acid is put into the tube *d*, so as to cover the holes in the tube *e*. *Use.*—When the apparatus is put over the hot crucible, the expanded air passes out by the tubes *f* and *e*, through the sulphuric acid in *d*, and finally through the chloride of calcium tube *g*. When the apparatus cools, atmospheric air re-enters to establish an equilibrium in the receiver *b*, through the tubes *g, d, e, f*. If in doing so, a little sulphuric acid is carried over mechanically, it is deposited in the tube *h*, suspended for its reception.

When the cooled crucible is removed from this apparatus, the substance within it is saturated with dry air at common pressure, and therefore is not disposed to attract moist air, as is the case when the crucible is cooled in air rarefied by heat.

ASSAY SHADES, to keep off Dust and Damp from preparations that are intended for Analysis, while being weighed, &c.

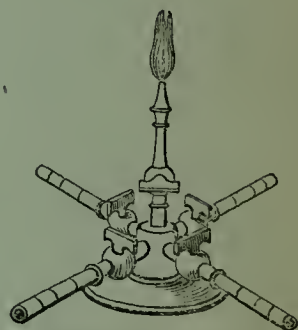
1301. Small Bell Receiver, with glass plate; diameter of the receiver and plate, inches, Figs. 1301, *a, b*, 1s. 6d.

1302. Bell Receiver with glass capsule, the receiver 3 inches wide, the basin 4 inches wide, both ground on the edges, Fig. 1302, 1s. 6d.
 1303. Glass Basin with cover, the basin 3 inches wide, Fig. 1303, 1s. 6d.
 1304. Ditto, the basin 4 inches wide, 2s.
 1305. Glass Capsules, watch glass form, ground on the edge, and fitted in pairs, to protect filters and hygroscopic substances from damp while being weighed. *Per pair*: 1½-inch, 6d.; 2-inch, 6d.; 2½-inch, 7d.; 3-inch, 8d.
 1306. Brass Spring Clips for holding the pair of capsules close together while being weighed, form of Fig. 1306, 6d.
 1307. Ditto, form of Fig. 1307, 6d.
 1308. Glass Plate, Tray, and oblong Bell Receiver, to protect substances from moisture during weighing, Bohemian glass, three pieces, all ground to fit exactly, weight of the whole between 150 and 250 grains; *price of the set in a box*, 4s.
 1309. Very light Glass Tubes, in which to weigh dried filters:

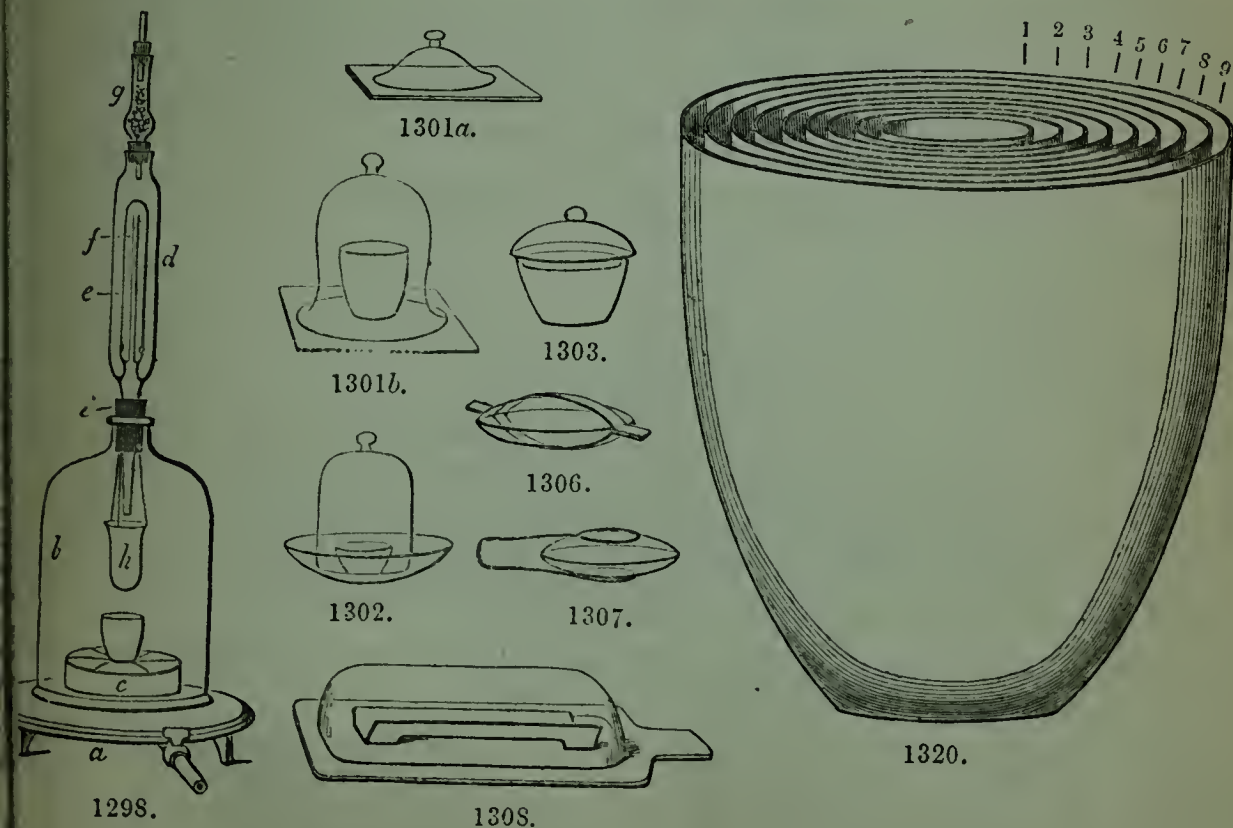
3½-inch by ¾-inch, 1½d.
 4½-inch by 1-inch, 1½d.

310. Gas Distributor, with five stopcocks, Fig. 1310, 9s.
 311. Ditto, superior style, with best stopcocks, 18s.

It is sometimes necessary, on a lecture table, or in a laboratory, to use several gas burners at once, where there happens to be only one supply pipe, or one source of gas. The apparatus represented by Fig. 1310, is then useful. One of its tubes can be attached to the supply pipe, and the three others to as many different burners or furnaces. The vertical tube, terminating in a very small jet, serves to keep a light always ready.



1310.



CRUCIBLES.

CRUCIBLES. CLASS 1.—PLATINUM.

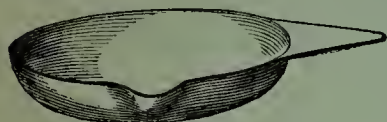
1320. PLATINUM CRUCIBLES, *best London manufacture.* Form of Fig. 1320, page 135.

No.	Diameter.	Depth.	Contents.	Weight.	Price.
			1 drachm.	120 grains.	10s.
1.	$\frac{5}{8}$ -inch.	$\frac{3}{4}$ -inch.	2 "	180 "	15s.
2.	$\frac{3}{4}$ -inch.	1-inch.	4 "	220 "	18s.
3.	1-inch.	$1\frac{1}{8}$ -inch.	5 "	340 "	28s.
4.	$1\frac{1}{8}$ -inch.	$1\frac{1}{4}$ -inch.	7 "	400 "	34s.
5.	$1\frac{1}{4}$ -inch.	$1\frac{1}{2}$ -inch.	$1\frac{1}{4}$ ounce.	480 "	40s.
6.	$1\frac{1}{2}$ -inch.	$1\frac{5}{8}$ -inch.	$1\frac{5}{8}$ "	580 "	48s.
7.	$1\frac{3}{4}$ -inch.	$1\frac{3}{4}$ -inch.	2 "	700 "	58s.
8.	2-inch.	$1\frac{7}{8}$ -inch.	$2\frac{3}{4}$ "	780 "	65s.
9.	$2\frac{1}{4}$ -inch.	2-inch.			

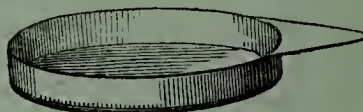
The prices quoted in the table are for crucibles without covers. If supplied with covers, the price are about one-third higher.

The prices are merely approximate. They change with the market price of the metal, and still more with variations in the thickness of the metal.

When a particular thickness of metal is desired, it should be ordered with reference to the scale of metal thicknesses given in No. 38, page 4. The weights given in the table, generally speaking are for such thin light crucibles as can be most readily heated over a spirit lamp. When greater strength is required, the crucibles must be made heavier.



1321a.



1321b.



1321c.

1321. COVERS FOR PLATINUM CRUCIBLES may be made either to bend over the outside of the crucible, as represented by Fig. 1321a, or in the form of capsules, Figs. 1321a and b, which kinds can, in fact, be used as capsules. The approximate prices of platinum capsules will be found under the head of Evaporation.

SILVER CRUCIBLES, of any size, made to order.

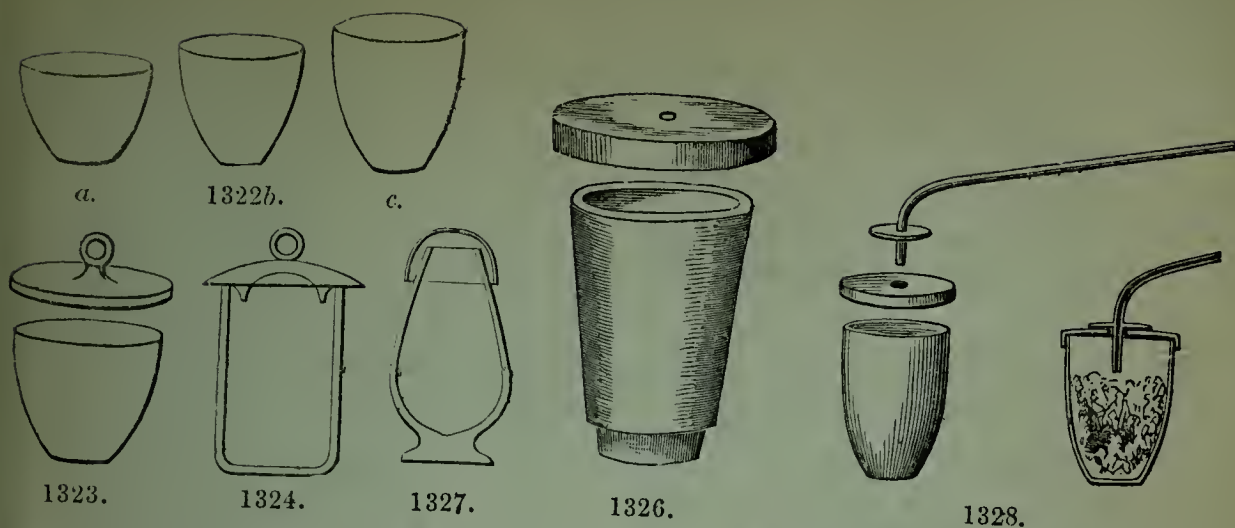
CRUCIBLES. CLASS 2.—PORCELAIN.

Porcelain Crucibles are preferable to those of platinum for igniting soils to destroy organic matter because in some cases the ignition of soils containing oxide of iron causes oxide of iron and, perhaps metallic iron to adhere so strongly to a platinum crucible, that it can only be detached by using aqua regia, which damages the platinum. When, therefore, the purpose is simply to destroy organic matter in a soil, a porcelain crucible should be used.

1322. *Comparison of the Shapes of the Thin Light Conical Porcelain Crucibles produced by different Manufacturers.*—Although crucibles made by the same manufacturer at different times are never exactly alike, those from each manufactory have a general character which may be pointed out for the guidance of those who wish to procure crucibles of a peculiar form. Fig. 1322, a, b, c, represent the three principal varieties of German porcelain crucibles. Fig. b is the form of the Berlin crucible, c, that of the Dresden or Meissen crucible, and a that of the Thuringian crucible. The latter is glazed inside, but biscuit outside. The two former are glazed all over, except the bottom outside. In general, the Dresden are the thinnest, and the Berlin the thickest of the three kinds.

1323. BERLIN PORCELAIN CRUCIBLES, best quality, very thin, highly glazed on both sides, conical form, Fig. 1323, with covers:

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	1-inch.	$\frac{1}{8}$ ounce.	3d.	2.	$2\frac{1}{4}$ -inch.	1 ounce.	10d.
00.	$1\frac{1}{4}$ "	$\frac{1}{4}$ "	4d.	3.	$2\frac{1}{2}$ "	2 "	1s.
0.	$1\frac{1}{2}$ "	$\frac{3}{8}$ "	6d.	4.	3 "	4 "	1s. 2
1.	$1\frac{3}{4}$ "	$\frac{1}{2}$ "	8d.	5.	$3\frac{1}{2}$ "	8 "	1s. 4



1324. Berlin Porcelain Crucibles, Liebig's form, Fig. 1324, cylindrical, with cover, glazed on both sides:—

No.	Diameter.	Height.	Contents.	Price.
1.	1-inch diameter.	$1\frac{1}{4}$ -inch high.	$\frac{1}{2}$ ounce.	5d.
2.	$1\frac{1}{2}$ „	$1\frac{3}{4}$ „	1 „	6d.

1325. Berlin Porcelain Crucible, cylindrical, form of *b*, Fig. 1336, biscuit, without cover, height 5 inches, width, $3\frac{1}{2}$ inches, contents 16 ounces, 1s.

1326. Berlin Porcelain Crucibles, conical form, Fig. 1326, for fusing nitrate of silver, &c. Biscuit, with perforated cover, to permit the escape of gases.

No.	Height.	Width.	Contents.	Price.
1.	$2\frac{1}{2}$ inches.	$1\frac{1}{2}$ -inch.	1 ounce.	6d.
2.	$3\frac{1}{4}$ „	2 inches.	$2\frac{3}{4}$ ounces.	7d.

1327. Berlin Porcelain Assayers' Crucibles, Fig. 1327, biscuit, with perforated cover.

No.	Height.	Diameter in the Middle.	Contents.	Price.
1.	$3\frac{3}{4}$ inches.	2 inches.	3 ounces.	1s.
2.	$4\frac{1}{2}$ „	$2\frac{3}{4}$ „	6 „	1s. 3d.

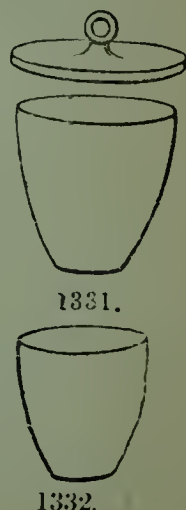
1328. Berlin Porcelain Apparatus for exposing substances to the action of oxygen or hydrogen gas at a red heat; consisting of a crucible, a perforated cover, and a gas-leading tube, all of biscuit porcelain, and fitted to one another, complete, Fig. 1328, 3s. 6d.

1329. The flanged tube alone, 3s.

1330. The crucible and cover, 9d.

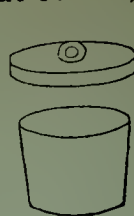
1331. DRESDEN PORCELAIN CRUCIBLES extremely thin and light, conical form, Fig. 1331, glazed both inside and outside, with covers.

No.	Diameter.	Depth.	Capacity.	Price.
1.	3 inches.	$2\frac{5}{8}$ inches.	6 ounce,	1s. 6d.
2.	$2\frac{3}{4}$ „	$2\frac{3}{8}$ „	4 „	1s. 2d.
3.	$2\frac{1}{2}$ „	2 „	3 „	1s.
4.	$2\frac{1}{4}$ „	$1\frac{7}{8}$ „	2 „	10d.
5.	$1\frac{3}{4}$ „	$1\frac{5}{8}$ „	$1\frac{3}{8}$ „	9d.
6.	$1\frac{5}{8}$ „	$1\frac{3}{8}$ „	$6\frac{1}{2}$ drachms,	8d.
7.	$1\frac{3}{8}$ „	$1\frac{1}{8}$ „	$4\frac{1}{2}$ „	7d.
8.	$1\frac{1}{8}$ „	$\frac{7}{8}$ „	$2\frac{1}{2}$ „	6d.
9.	1 „	$\frac{3}{4}$ „	40 grains,	5d.
10.	$\frac{5}{8}$ „	$\frac{1}{2}$ „	15 „	5d.
11.	$\frac{1}{2}$ „	$\frac{1}{4}$ „	10 „	5d.



1332. Dresden Crucibles, No. 9, 10, 11, without covers, Fig. 1332, at 3d. *each*.

1333. Plattner's Blowpipe Crucible, Dresden porcelain, conical, with flat bottom, Fig. 1333, glazed, very thin, for use in the qualitative analysis of minerals by the blowpipe, with cover, 1-inch high, 1½-inch diameter, contents ½-ounce, 6d.



1333.



1335.



1335.

1334. The same, without the cover, 4d.

1335. THURINGIAN PORCELAIN CRUCIBLES, conical form, wide mouth, with cover Fig. 1335 and 1322 *a*, glazed inside, biscuit outside.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1	1 inch.	$\frac{1}{4}$ ounce.	4d.	6	2¾ inches.	3 ounces.	10d.
2	1½ "	$\frac{1}{2}$ "	5d.	7	3 "	4 "	1s.
3	2 "	1 "	6d.	8	3¼ "	6 "	1s. 3d.
4	2¼ "	2 "	7d.	9	3⅝ "	8 "	1s. 8d.
5	2½ "	2½ "	8d.	<i>The Set of Nine,</i>			7s.

1336. Thuringian Porcelain Crucibles, biscuit inside and outside, suitable for fusions at high temperatures, with spout, tall and narrow, form of Fig. 1336: *a* the cover, *b* the crucible, *c* the support to put below it in a furnace.



1336.

The following prices include Crucible and Cover, but not the Support:—

No.	Height.	Diameter.	Contents.	Price.	No.	Height.	Diameter.	Contents.	Price.
1	1¾-inch.	1¼-inch.	$\frac{1}{2}$ oz.	4d.	7	4¼-inch.	3-inch.	8 oz.	1s. 4d.
2	2 "	1½ "	1 "	5d.	8	4¾ "	3¼ "	12 "	1s. 6d.
3	2½ "	2 "	2 "	6d.	9	5½ "	3½ "	16 "	1s. 9d.
4	3¼ "	2½ "	4 "	10d.	10	9 "	4 "	24 "	2s.
5	3½ "	2½ "	5 "	1s.	11	9½ "	4 "	32 "	2s. 6d.
6	4 "	2½ "	6 "	1s. 2d.					

1337. Crucibles of the above quality and sizes, *glazed inside*, with covers, at the following prices:—

No. 1.	5d.	No. 4.	1s.	No. 7.	1s. 8d.	No. 10.	2s. 6d.
" 2.	6d.	" 5.	1s. 2d.	" 8.	1s. 10d.	" 11.	3s.
" 3.	7d.	" 6.	1s. 4d.	" 9.	2s.		

1338. Supports for the Crucibles in the furnace, fireclay, form of *c*, Fig. 1336. the sizes 2d. *each*.

2 by ¾-inch. | 2½ by ¾-inch. | 3 by 1-inch. | 3½ by 1-inch.

1339. BERLIN SEMI-PORCELAIN CRUCIBLES, glazed within and without, with covers, form of Fig. 1339.

No. 1.	5 ounce,	9d.	No. 3.	10 ounce,	1s. 3d.
" 2.	8 "	1s.	" 4.	16 "	1s. 6d.

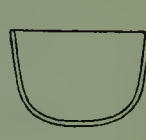


1339.

1340. Assay Crucibles, formed of a rough white refractory mass (Berlin semi-porcelain) in which cast iron may be fused, in nests of seven, the largest size, 7 inches by 5, with covers, 9s.
 1341. Ditto, without covers, 6s. 6d.
 1342. Ditto, the five smallest, without covers, 3s.



1343. PORCELAIN CUPS, for use in ignitions, as uncovered crucibles. Many varieties are figured and described under the head of "EVAPORATION." These Cups are often of great use in chemical operations, that are performed with small quantities of materials. As a substance may be dissolved in an acid, its solution be evaporated to dryness, and the dry product be ignited in one vessel. See PLATTNER'S *Treatise on the Blowpipe*, especially the sections on the Analysis of Minerals and Metalliferous Substances by the Combination of the Wet and Dry Processes of Analysis.



1343.

CRUCIBLES. CLASS 3. PLUMBAGO.

1346. PATENT PLUMBAGO CRUCIBLES, suitable for the fusion of the most refractory metals, gold, silver, brass, copper, steel, iron, &c.; not subject to crack, and may be used repeatedly for most metals. Fig. 1346.



1346.

Each No. is equal to the bulk of $2\frac{1}{10}$ -lbs. of copper.

No.	Per dozen.	No.	Per dozen.	No.	Each.	No.	Each.
1	4s.	12	48s.	30	10s.	80	27s.
2	8s.	14	56s.	35	12s.	90	30s.
4	16s.	16	64s.	40	14s.	100	33s.
6	24s.	18	72s.	50	17s.	200	66s.
8	32s.	20	80s.	60	20s.	300	100s.
0	40s.	25	100s.	70	24s.	400	133s.

347. Covers for Patent Plumbago Crucibles, all sizes, at $1\frac{1}{4}$ d. per Number.
 348. Black-lead Pots, suitable for melting old metals, when strong fluxes are used, but not resisting change of temperature like the Patent Plumbago Crucibles.

No.	Per dozen.	No.	Per dozen.	No.	Each.	No.	Each.
1	1s. 9d.	7	12s. 6d.	16	2s. 9d.	40	8s.
2	3s. 6d.	8	14s.	18	3s. 2d.	50	10s.
3	5s. 3d.	9	16s. 6d.	20	3s. 6d.	60	12s.
4	7s.	10	18s. 6d.	25	4s. 6d.	70	14s.
5	9s. 6d.	12	21s.	30	5s. 6d.	80	16s.
6	11s.	14	24s. 6d.	35	6s. 6d.	100	19s.

- 348 a. Covers for Black-lead Crucibles at $1\frac{1}{4}$ d. per Number.
 349. Cornish Black-lead Crucibles, for the assay of tin ores, $3\frac{1}{2}$ inches high, 3 inches wide, per dozen, form of Fig. 1358, 9s.
 350. Blocks of Patent Plumbago, to support crucibles in the furnace, at $1\frac{1}{4}$ d. per Number.
 351 Plumbago Stirrers, best quality, per dozen, 16s.

CRUCIBLES. CLASS 4. FIRE-CLAY.

1352. LONDON-MADE FIRE-CLAY CRUCIBLES, round conical form, of the best manufacture, capable of resisting high temperatures and the action of fluxes, will retain melted copper and cast-iron, and, when heated to *softening*, they retain their compact structure, and do not become vesicular.



1352.

No.	Height.	Price. Per Dozen.	Covers. Per Dozen.	No.	Height.	Price. Per Dozen.	Covers. Per Dozen.
1	1 $\frac{3}{4}$ inch	4d.	1s. 3d.	5 $\frac{1}{2}$	5 $\frac{1}{2}$ inch	3s. 9d.	2s.
1 $\frac{1}{2}$	2 $\frac{1}{8}$ "	5d.	1s. 3d.	6	6 $\frac{1}{2}$ "	4s. 6d.	2s.
2	2 $\frac{1}{2}$ "	7d.	1s. 3d.	6 $\frac{1}{2}$	6 $\frac{7}{8}$ "	6s. 6d.	2s. 6d.
1 $\frac{1}{2}$	2 $\frac{5}{8}$ "	8d.	1s. 3d.	7	7 $\frac{1}{4}$ "	7s. 6d.	2s. 6d.
2	2 $\frac{3}{4}$ "	9d.	1s. 3d.	8	8 $\frac{1}{4}$ "	10s.	3s. 3d.
2 $\frac{1}{2}$	3 $\frac{1}{4}$ "	1s.	1s. 3d.	9	9 $\frac{1}{4}$ "	12s. 6d.	3s. 3d.
3	3 $\frac{3}{8}$ "	1s. 1d.	1s. 3d.	10	10 "	19s.	4s.
3 $\frac{1}{2}$	3 $\frac{5}{8}$ "	1s. 6d.	1s. 3d.	11	11 "	24s.	4s. 6d.
4	4 $\frac{1}{4}$ "	2s.	1s. 3d.	12	12 "	30s.	5s.
4 $\frac{1}{2}$	4 $\frac{3}{4}$ "	2s. 6d.	2s.	13	13 "	35s.	
5	5 $\frac{1}{4}$ "	3s. 3d.	2s.	14	14 "	45s.	

1353. London-made Fire-clay Crucibles, of *triangular* form, Fig. 1354, at the same Prices as the Round Crucibles, No. 1352.

1354. HESSIAN CRUCIBLES, refractory fire-clay, triangular, Fig. 1354.



1354.

Sizes ... No. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.
Inches high ... 1, 2, 2 $\frac{1}{2}$, 3, 3 $\frac{1}{2}$, 4 $\frac{1}{2}$, 6 $\frac{3}{4}$, 7, 8, 9 $\frac{1}{2}$.

No.	Prices of Nests.	Single Crucibles Per Dozen.	Covers Per Dozen.
1.	Nest of 3, No. 2 to 4, 3d.	No. 1, 3d.	1s. 3d.
2.	" 5, small, 1 " 5, 5d.	2, 6d.	1s. 3d.
3.	" 5, large, 2 " 6, 7d.	3, 1s.	1s. 3d.
4.	" 6, " 2 " 7, 1s. 3d.	4, 2s.	1s. 3d.
5.	" 8, " 1 " 8, 1s. 6d.	5, 3s.	2s.
6.	" 10, " 1 " 10, 5s.	6, 4s.	2s.
		7, 6s.	2s. 6d.
		8, 8s.	3s. 3d.

CORNISH CRUCIBLES.

1355. Cornish Assay Crucibles, best quality, rough white fire-clay, form of Fig. 1355.

No. 1. 2 to 2 $\frac{1}{2}$ inches high, 2s. doz.	No. 3. 4 inches high, 3s. doz.
2. 3 " 3 $\frac{1}{2}$ " 2s. 6d. "	4. 4 $\frac{1}{2}$ " 4s. "

1356. Nest of three large sizes, 2 $\frac{1}{2}$, 3 $\frac{1}{2}$, and 4 $\frac{1}{2}$ inches, per dozen nests, 8s.

1357. Nest of three small sizes, 2, 3, and 3 $\frac{1}{2}$ inches, per dozen nests, 6s.

1358. Cornish Metallurgists' Crucibles, somewhat smoother than the Cornish Assay Crucibles, and of a conical form (Fig. 1358), occasionally with small spouts.

No. 1. 1-inch 1d.	No. 5. 4-inch 3d.	No. 9. 6-inch 7d.
2. 2 " 1 $\frac{1}{2}$ d.	6. 4 $\frac{1}{2}$ " 4d.	10. 7 " 11d.
3. 3 " 2d.	7. 5 " 5d.	11. 8 " 14d.
4. 3 $\frac{1}{2}$ " 2 $\frac{1}{2}$ d.	8. 5 $\frac{1}{2}$ " 6d.	

359. Cornish Triangular Crucibles, nest of 4 sizes, $1\frac{1}{2}$, $2\frac{1}{4}$, $2\frac{1}{2}$, and 4 inches, per dozen nests, 6s.

The sizes of Cornish Crucibles are stated approximately. They are very irregular both in form and size, the nature of the material not permitting of fine workmanship.



1355.



1358.



1359.



1360.

360. French Assay Crucibles, or Fluxing Pots, from the Factory of Beaufay; soft, white material, smooth surface, tall narrow form (Fig. 1360), with spout. Covers charged separately. See No. 1360a.

No.	Inches High.	Inches Wide.	Price.	No.	Inches High.	Inches Wide.	Price.	No.	Inches High.	Inches Wide.	Price.
0	$1\frac{1}{2}$	$1\frac{2}{5}$	$1\frac{1}{2}$ d.	8	$4\frac{3}{4}$	$2\frac{2}{3}$	6d.	16	$10\frac{1}{2}$	$5\frac{1}{2}$	2s. 6d.
1	2	$1\frac{2}{5}$	$1\frac{1}{2}$ d.	9	$5\frac{1}{3}$	3	9d.	17	11	6	3s.
2	$2\frac{1}{5}$	$1\frac{3}{5}$	2d.	10	6	$3\frac{1}{2}$	10d.	18	12	$6\frac{1}{2}$	4s.
3	$2\frac{3}{4}$	$1\frac{4}{5}$	3d.	11	$6\frac{1}{2}$	$3\frac{2}{3}$	1s.	19	13	$6\frac{3}{4}$	4s. 6d.
4	$3\frac{1}{5}$	2	3d.	12	$6\frac{3}{4}$	4	1s. 4d.	20	$13\frac{1}{2}$	7	5s. 6d.
5	$3\frac{1}{4}$	$2\frac{1}{5}$	3d.	13	$7\frac{1}{2}$	4	1s. 6d.	21	$14\frac{1}{2}$	$6\frac{3}{4}$	6s. 6d.
6	$3\frac{1}{2}$	$2\frac{1}{4}$	4d.	14	$8\frac{1}{2}$	$4\frac{2}{5}$	2s.	22	$15\frac{1}{2}$	7	7s. 6d.
7	$4\frac{1}{2}$	$2\frac{2}{5}$	5d.	15	$9\frac{1}{2}$	$5\frac{1}{5}$	2s. 4d.	—	—	—	—

360a. Covers for the French Fluxing Pots. Price according to the diameter.

No. 1. Under $2\frac{1}{2}$ inches wide, 2d.	No. 5. Under 6 inches wide, 7d.
2. „ 4 „ „ 3d.	6. „ 7 „ „ 10d.
3. „ $4\frac{1}{2}$ „ „ 5d.	7. „ $8\frac{1}{2}$ „ „ 1s.
4. „ 5 „ „ 6d.	

361. Skittle Pots, Fire-clay, without covers, for purifying jewellers' sweep, &c. Price per dozen:—

3-inch 1s. 4d.	7-inch 4s.	11-inch 12s.	18-inch 56s.
4 „ 2s.	8 „ 5s.	12 „ 16s.	20 „ 80s.
5 „ 2s. 8d.	9 „ 6s.	14 „ 22s.	
6 „ 3s. 4d.	10 „ 9s.	16 „ 27s.	



1361.

362. Metallurgists' Crucibles (Poelons), of refractory fire-clay, for the reduction and fusion of metals, globular form, narrow mouth, on foot, Fig. 1362:—

No. 1. $1\frac{1}{8}$ -inch high by $1\frac{1}{8}$ -inch diameter, per dozen, 2s. 6d.	1362.
2. $1\frac{3}{8}$ „ „ $1\frac{5}{8}$ „ „ 2s. 6d.	
3. $2\frac{1}{4}$ „ „ 2 „ „ 3s. 3d.	

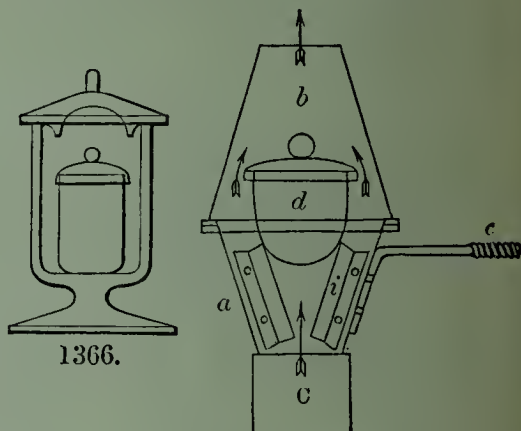


1365. Fire-clay Supports, for Crucibles in a Furnace; to keep them at a distance from the grate, French:—

No.	Height.	Diameter.	Price.	No.	Height.	Diameter.	Price.
1.	1 $\frac{1}{5}$ -inch	1 $\frac{1}{5}$ -inch	2d.	5.	1 $\frac{3}{4}$ -inch	6-inch	10d.
2.	1 $\frac{1}{5}$ „	2 „	3d.	6.	3 „	6 „	1s.
3.	1 $\frac{1}{5}$ „	3 $\frac{1}{2}$ „	4d.	7.	4 $\frac{1}{4}$ „	6 „	1s. 3d.
4.	1 $\frac{1}{5}$ „	7 „	8d.				

1366. CRUCIBLE CASES, of refractory fire-clay, with feet and covers, Fig. 1366, intended to protect Porcelain or Platinum Crucibles from contact with the coal in a fire, and to elevate them to a proper height above the grate.

Inside Measurement.			
No.	Depth.	Width.	
1,	2 $\frac{1}{2}$ inches.	2 inches,	6d.
2,	3 "	2 "	7d.
3,	2 $\frac{3}{4}$ "	2 $\frac{1}{2}$ "	8d.
4,	3 $\frac{1}{4}$ inches.	2 $\frac{1}{2}$ inches,	9d.
5,	3 "	3 "	10d.
6,	4 "	3 "	1s.



1367. Infusible Fire-clay Stirrers, for mixing powders in crucibles. See No. 110.

1368. Crucible Tongs. See Tongs, No. 120, page 12.

1369. IRON CRUCIBLE JACKET, for supporting a Platinum Crucible over a Spirit Lamp, Fig. 1369, 1s. 6d.

The Crucible Jacket is intended to hold a Crucible over a spirit lamp, in such a manner as to exclude all atmospheric air, except what passes up the chimney of the lamp. The Crucible is supported by three knife edges, so placed as not to obstruct the action of the flame. C, chimney of the spirit lamp; a, crucible jacket with the knife edges i; b, moveable cover; c, handle with screw adapted to the thumb-screw of a lamp rod; d, the crucible. The arrows show the direction of the flame.

CRUCIBLES. CLASS 5. IRON.

1370. Thin cast-iron Crucibles, form of Fig. 1333, with Covers:—

No. 1.	2 inches high, 2 inches wide, contents, 3 $\frac{1}{2}$ -oz.,	9d.
2.	2 $\frac{1}{4}$ „ 2 $\frac{1}{4}$ „ „ 5 „	1s.
3.	3 „ 2 $\frac{1}{2}$ „ „ 8 „	1s. 6d.
4.	The set of three crucibles	3s.



1371. Wrought-iron Crucible, stout, form of Fig. 1371, without cover, 4-inch, 3s.



1372.

1371.

TUBE OPERATIONS.

Only Porcelain Tubes and Iron Tubes will be noticed here. Operations with Glass Tubes are described in many other sections. See Gas Combustion Furnace, Nos. 1051 to 1090, the Articles on Organic Analysis, and on Apparatus for Experiments with Gases.

PORCELAIN TUBES.

Porcelain Tubes for containing substances that are to be exposed to heat in a furnace, while gases are passed over them; or for exposing a current of any gas to the action of heat.

The furnaces suitable for use with tubes are described at Nos. 846 and 1064.

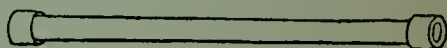
1373. TUBES OF BERLIN PORCELAIN, without collars, glazed both inside and outside.

These can be supplied of the following diameters, namely, $\frac{1}{2}$, $\frac{3}{4}$, $1\frac{1}{8}$, $1\frac{1}{2}$, 2, and $2\frac{1}{4}$ inches, and of any length from 12 inches up to 52 inches. The following sizes are generally kept in stock:—

No.	Diam.	Length.	No.	Diam.	Length.	No.	Diam.	Length.
1.	$\frac{1}{2}$ -in.	12-in. 1s. 6d.	6.	$\frac{3}{4}$ -in.	35-in. 9s.	11.	$1\frac{1}{8}$ -in.	40-in. 15s.
2.	$\frac{1}{2}$ „	20 „ 3s.	7.	$\frac{3}{4}$ „	40 „ 12s.	12.	$1\frac{1}{2}$ „	26 „ 12s.
3.	$\frac{1}{2}$ „	26 „ 4s.	8.	$1\frac{1}{8}$ „	20 „ 6s.	13.	$1\frac{1}{2}$ „	35 „ 16s.
4.	$\frac{3}{4}$ „	20 „ 4s. 6d.	9.	$1\frac{1}{8}$ „	26 „ 9s.	14.	2 „	35 „ 18s.
5.	$\frac{3}{4}$ „	26 „ 6s.	10.	$1\frac{1}{8}$ „	35 „ 14s.	15.	$2\frac{1}{4}$ „	52 „ 27s.

The sizes are stated in Prussian inches, which are about $\frac{1}{4}$ longer than English inches.

1374. TUBES OF DRESDEN PORCELAIN, with collar at each end (Fig. 1374), glazed inside, biscuit outside; length, 24 inches.



1374.

No. 1. Bore $1\frac{3}{8}$ -inch	4s.	No. 3. Bore $\frac{5}{8}$ -inch	2s. 3d.
2. „ 1 „	3s.	4. „ $\frac{3}{8}$ „	1s. 9d.

1375. Tubes of Thuringian Porcelain, Figure 1374, but with collar at one end only, glazed inside, biscuit outside; bore $\frac{3}{4}$ -inch, outside diameter about 1 inch. Price according to length, as follows:—

12 inches	1s.	21 inches	2s. 6d.	30 inches	5s.
18 „	2s.	24 „	3s. 6d.		

1376. Tube of Thuringian Porcelain, glazed inside and outside, for exciting electricity; $24\frac{1}{2}$ inches long, $1\frac{1}{4}$ -inch bore, and nearly 2 inches outside diameter, without collar, 4s. 6d.

1377. Tubes of Thuringian Porcelain, with a collar at one end and a small neck at the other, to enable them to be fitted together for conducting gases or liquids, 36 inches long, bore $1\frac{3}{4}$ -inch, outside diameter $2\frac{1}{4}$ -inch, 8s. 6d.

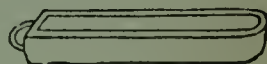
1378. Tubes of Wedgwood's Porcelain, 18 inches long:—

1-inch bore, 1s. 6d.; $1\frac{1}{2}$ -inch bore, 2s.; 2-inch bore, 3s.

1379. Fire-clay Tubes, glazed inside, *Grès verni de la fabrique d'Orléans*, 22 inches long: $\frac{3}{4}$ -inch bore, 1s. 3d.; 1-inch bore, 1s. 6d.; $1\frac{1}{4}$ -inch bore, 1s. 9d.

1380. BOAT-SHAPED TRAYS, of Porcelain, to contain solid substances which are to have gases passed over them while they are heated to redness in tubes.

No. 1.	$2\frac{1}{4}$ inches long,	$\frac{1}{2}$ inch wide,	Berlin Porcelain,	5d.
2.	3 „	$\frac{1}{2}$ „	„	5d.
3.	4 „	$\frac{1}{2}$ „	„	5d.
4.	3 „	$\frac{1}{2}$ „	Thuringian Porcelain,	4d.
5.	3 „	$\frac{1}{2}$ „	Meissen „	5d.
6.	3 „	$\frac{3}{8}$ „	„	4d.
7.	$5\frac{1}{2}$ „	$1\frac{1}{4}$ „	„	8d.



1380.

8. Boat-shaped Tray of Platinum, price, according to weight, 15s. to 21s.

IRON PIPES AND JOINTS.

1381. Iron Pipes are frequently required in the construction of chemical apparatus; such as the arrangements for the conveyance of gases, for the prolongation of the necks of iron retorts when used for destructive distillation, or in the preparation of gases, for containing substances to be exposed to a red heat in a furnace, while subjected to the action of a current of some kind of gas, and for various other purposes. I give here, therefore, some account of the Pipes, Joints, and Fittings in most frequent demand, with a list of their prices. The pieces are all provided, at the given prices with the screws represented in the Figures, which fit well together, but these prices do not include the cost of the fitting together of these pieces into special complex forms of apparatus, or of attaching them to retorts, &c., on which additional screws require to be cut. Such compound apparatus is priced according to the amount of work it requires.

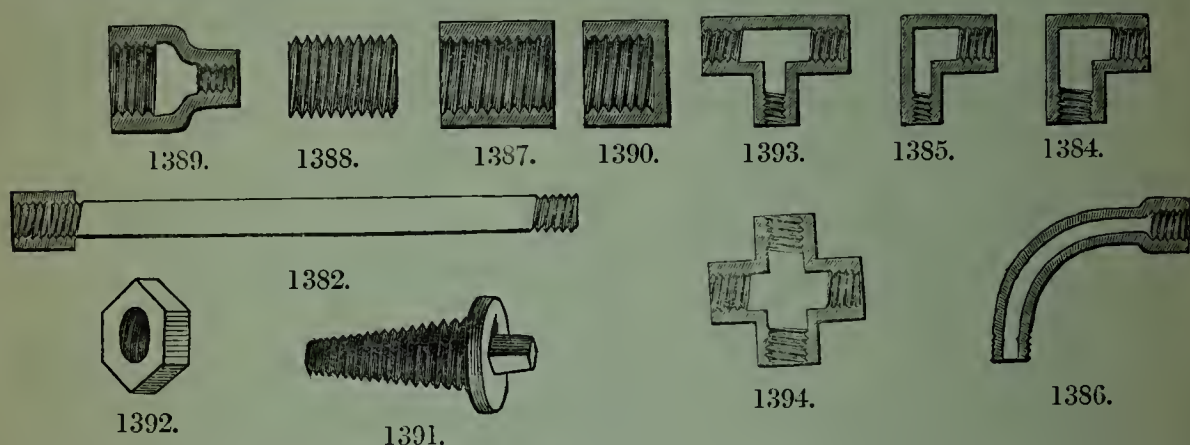


Fig.	Bore of the Pipe in inches.	2.	1½.	1¼.	1.	¾.	½.	⅜.	¼.
1382.	Long Pipes, <i>per foot.</i>	1s. 9d.	1s. 1d.	10d.	7d.	5d.	5d.	4d.	
1383.	Short Pipes, <i>per foot.</i>	3s.	2s.	1s. 9d.	1s. 3d.	1s.	9d.	7d.	
1384.	Elbow-joint.	3s. 9d.	2s. 3d.	1s. 9d.	1s.	10d.	8d.	7d.	
1385.	Diminishing Elbow-joint.	3s. 9d.	2s. 3d.	1s. 9d.	1s.	10d.	8d.	7d.	
1386.	Elbow Bend.	3s. 9d.	2s. 3d.	1s. 9d.	1s.	10d.	8d.	7d.	
1387.	Plain Socket.	1s.	8d.	7d.	5d.	4d.	3d.	3d.	
1388.	Nipple.	1s. 3d.	9d.	7d.	6d.	5d.	5d.	5d.	
1389.	Diminishing Socket.	1s. 3d.	9d.	8d.	6d.	5d.	5d.	5d.	
1390.	Cap.	1s. 3d.	9d.	7d.	6d.	5d.	5d.	5d.	
1391.	Plug.	1s. 3d.	9d.	7d.	6d.	5d.	5d.	5d.	
1392.	Back Nut.	1s. 3d.	9d.	7d.	6d.	5d.	5d.	5d.	
1393.	Tee-piece.	4s.	2s. 6d.	2s.	1s. 6d.	1s. 2d.	9d.	8d.	
1394.	Cross-piece.	6s.	3s. 6d.	3s.	2s. 3d.	1s. 9d.	1s. 6d.	1s. 3d.	1s.

1395. *Explanation.*—The standard for size is the *bore of the iron pipe*. Thus, under 1-inch bore, the prices are quoted of joints, the screws of which fit the screws on a pipe of 1-inch bore. By *long pipes* is meant any pipe not less than 2 feet long, nor more than 12 feet long. By *short pipes*, all lengths that are less than 2 feet. The elbow-joint, Fig. 1384, is for connecting two pipes at a right angle. The diminishing elbow-joint, Fig. 1385, serves this purpose for pipes that differ in the bore. The elbow-bend, Fig. 1386, makes a joint with a curve. The plain socket, Fig. 1387, and nipple, Fig. 1388, serve to connect two pipes of the same bore, and in the same straight line. The diminishing socket, Fig. 1389, is used to connect two pipes of different sizes in the same straight line. The cap, Fig. 1390, and plug, Fig. 1391, serve to close the ends of pipes. The back nut, Fig. 1392, is employed to make a tight joint. The cross-piece, Fig. 1394, and the tee-piece, Fig. 1393, are used to connect together pipes that run in several directions.

1396. IRON MELTING LADLES, with long handles, for the granulation of zinc and the fusion of cements, tin, lead, bismuth, antimony, &c.

1½-inch Bowl, 6d.; 2-inch, 7d.; 2½-inch, 8d.; 3-inch, 9d.; 4-inch, 10d.; 5-inch, 11d.

A Special Gas Furnace, for melting zinc, lead, &c., is described at No. 1008.

Iron Pots, for melting lead, zinc, and other easily fusible metals, are described at Nos. 1226, 1227.



1400.



1401.



1421.



1420.



1422.



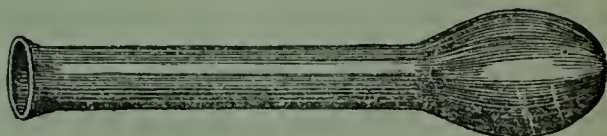
1409.



1408.



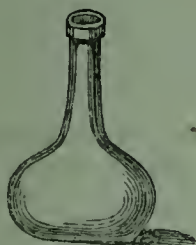
1419b.



1419a.



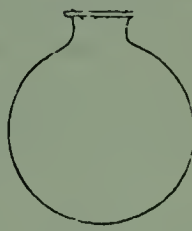
1404a.



1404b.



1407.



1414.



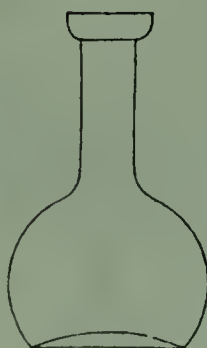
1406.



1405b.



1405a.



1404c.



1415.



1411.



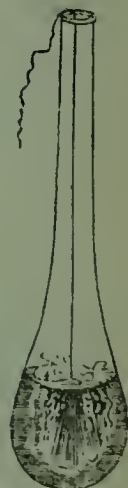
1423.



1410.



1417.



1419c.



1416.

Vessels for preparing Solutions.

FLASKS.
WOULFF'S BOTTLES.
BEAKERS.

PORCELAIN BOILERS.
DIGESTERS.
JARS WITHOUT FEET.

JARS WITH FEET.
STOPPERED JARS.
PANS.

FLASKS.

The figures on page 145, represent most of the forms of Glass Flasks, for boiling liquids or preparing gases, that are now in use among chemists. Figs. 1400 and 1401, represent flasks which have phial lips or turned-over mouths to fit them to receive corks. Figs. 1404 and 1405, represent flasks, the mouths of which are strengthened by a welt or band of glass melted round the neck, then have the necks cut off and ground down close to the welt. These mouths are not so convenient for corking or for pouring as the phial lips, but they are much stronger, and less liable to crack. Figs. 1411 and 1423 have plain unprepared mouths. All the above forms of flasks are prepared of glass, uniform in substance, both at the sides and bottom, without a punty mark or knob in the middle of the bottom, and are entirely free from lead in their position.

The sizes are expressed in OUNCES of water, the PINT containing 20 OUNCES.

1400. GERMAN HARD GLASS FLASKS, flat bottoms, with phial lip, uniform in substance, form of Figs. 1400 and 1401, when under 3 pints capacity; above that size, form of Figs. 1404a, b, c, namely, with welted mouth.



1400.



1401.



1404a.



1404b.



1404c.

PRICE PER DOZEN.

1-ounce, 1s. 6d.	8-ounce, 3s. 6d.	1 1/4 pint, 7s.	4 pints, 1l.
2 " 2s.	9 " 4s.	1 1/2 " 8s.	4 1/2 " 1l.
2 1/2 " 2s.	10 " 4s. 3d.	1 3/4 " 9s.	5 " 2l.
3 " 2s. 3d.	12 " 4s. 6d.	2 pints, 10s.	6 " 2l.
4 " 2s. 6d.	14 " 4s. 9d.	2 1/2 " 11s.	7 " 2l.
5 " 2s. 9d.	16 " 5s.	3 " 12s.	8 " 3s.
6 " 3s.	18 " 5s. 6d.	3 1/2 " 14s.	10 " 3s.
7 " 3s. 3d.	1 pint, 6s.		

101. BOHEMIAN HARD GLASS FLASKS, best quality, made of the same glass as the Hard Bohemian Beakers, and of the same shape as the flasks No. 1400—namely, those under 3 pints, of the form of Figs. 1400 and 1401; above 3 pints, form of Fig. 1404*a, b, c*.

PRICE PER DOZEN.

1 ounce, 3s.	7 ounces, 5s. 6d.	18 ounces, 8s. 6d.	4 pints, 16s.
2 „ 3s.	8 „ 6s.	1 pint, 9s.	5 „ 20s.
2½ „ 3s.	9 „ 6s. 6d.	1¼ „ 10s.	6 „ 24s.
3 „ 3s. 3d.	10 „ 7s.	1½ „ 10s. 6d.	7 „ 28s.
4 „ 4s.	12 „ 7s.	2 pints, 12s.	8 „ 30s.
5 „ 4s. 6d.	14 „ 7s. 6d.	2½ „ 13s.	9 „ 31s. 6d.
6 „ 5s.	16 „ 8s.	3 „ 14s.	10 „ 33s.

1402. Mixing Flasks, namely, hard German or Bohemian globular flasks, with flat bottoms, form of Fig. 1402, with very short and wide necks, for use as Mixing Flasks in Centigrade Testing. Contents, 3 to 4 ounces; *per dozen*, 4s.

1403. FRENCH FLASKS, white glass, Figs. 1400 and 1403, flat bottom, and phial lip for corking, no punty mark, not of hard glass like the German and Bohemian flasks, nor so stout in the glass, but suitable for boiling.



1402.

Price per Dozen.		Price per Dozen.	
1 ounce.	1s. 3d.	10 ounces.	3s. 3d.
2 „	1s. 4d.	12 „	3s. 6d.
3 „	1s. 5d.	14 „	4s.
4 „	1s. 6d.	16 „	4s. 6d.
4½ „	1s. 9d.	18 „	4s. 9d.
5 „	2s.	1 pint.	5s.
6 „	2s. 3d.	1¼ „	5s. 6d.
7 „	2s. 6d.	1½ „	6s.
8 „	2s. 9d.	1¾ „	7s.
„	3s.	2 „	8s.



1403.

1404. FRENCH FLASKS, crown glass, slightly tinted with green, globular form with thin flat bottom, the mouths welted and ground, form of Fig. 1404 *a, b, c*.

Price per Dozen.		Price per Dozen.		Price per Dozen.	
1 ounce.	1s. 2d.	9 ounce.	2s. 9d.	1¾ pints.	6s.
2 „	1s. 3d.	10 „	3s.	2 „	7s.
3 „	1s. 4d.	12 „	3s. 6d.	2½ „	8s.
4 „	1s. 5d.	14 „	3s. 9d.	3 „	9s.
4½ „	1s. 6d.	16 „	4s.	3½ „	10s. 6d.
5 „	1s. 9d.	18 „	4s. 3d.	4 „	12s. 6d.
6 „	2s.	1 pint.	4s. 6d.	5 „	16s.
7 „	2s. 3d.	1¼ „	5s.	6 „	20s.
8 „	2s. 6d.	1½ „	5s. 6d.	8 „	24s.

1405. FRENCH BALLONS, or Flasks of gobular form, round bottom, with short, wide necks, and welted and ground mouths, Figs. 1405*a, b*, white glass. These serve also as Plain Receivers, for use with Retorts in distillation.

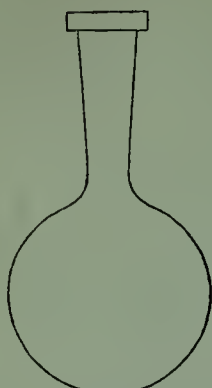
Price per Doz.		Price per Doz.		Price per Doz.	
1 to 2½ ounces.	2s.	16 ounces.	4s. 6d.	2½ pints.	10s.
3 and 4 „	2s. 3d.	18 „	4s. 9d.	3 „	12s.
5 and 6 „	2s. 6d.	1 pint.	5s.	3½ „	14s.
7 and 8 „	3s.	1¼ „	6s.	4 „	16s.
9 and 10 „	3s. 6d.	1½ „	7s.	5 „	18s.
12 „	3s. 9d.	1¾ „	8s.	6 „	24s.
14 „	4s.	2 pints.	9s.	8 „	30s.

1406. Bohemian Gas Bottles, upright form, Fig. 1406; hard glass, uniformly thick with welged and ground mouth. Price per Dozen:—

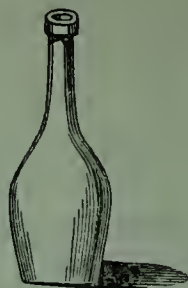
$\frac{1}{2}$ pint.	8s.	2 pints.	12s.	4 pints.	18s.
1 „	10s.	3 „	15s.	5 „	24s.



1405 a.



1405 b.



1406.



1407.



1408.



1409.

1407 Flasks, to fix on a ring over a lamp or gas burner, Fig. 1407, Bohemian glass
 3 ounces, 5s. per dozen. | 6 ounces, 8s. per dozen. | 10 ounces, 10s. 6d. per dozen
 4 „ 6s. „ | 8 „ 9s. „ | 20 „ 14s. „

1408. Triangular Flasks, for exposing a large surface of solid matter to the action of a liquid, or for boiling a liquid with rapidity over a rose gas burner. Fig. 1408, best hard white Bohemian glass, uniform in substance, with turned-over mouth for corking.

$\frac{1}{4}$ pint, 9d.	1 pint, 1s. 6d.	$2\frac{1}{2}$ pints, 2s. 3d.
$\frac{1}{2}$ „ 1s.	$1\frac{1}{2}$ „ 1s. 9d.	3 „ 2s. 6d.
$\frac{3}{4}$ „ 1s. 3d.	2 „ 2s.	4 „ 3s.

1409. Pear-shaped Flask, round bottom, and tapering gradually to the neck, which about $\frac{3}{4}$ inch diameter, and turned over for corking, Fig. 1409, fine white French glass. Contents 16 ounces, per dozen, 3s. 6d.

1410. Globular Flask, with wide cylindrical neck, having a contraction near the mouth, fine white hard German glass, Fig. 1410.

10 ounces, 9d.	20 ounces, 1s.	35 ounces, 1s. 6d.
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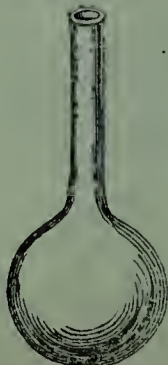
1411. Bolt Heads, or Globular Flasks, Fig. 1411, hard white Bohemian glass.

$\frac{1}{4}$ pint. 6d.	1 pint. 9d.	4 pints. 1s. 6d.
$\frac{1}{2}$ „ 8d.	2 „ 1s.	6 „ 2s. 6d.

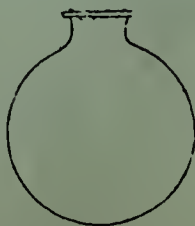
1412. Bolt Heads, of hard white glass, Fig. 1411, the globe from 8 to 12 inch diameter, the neck about 18 inches long and 3 inches diameter, white German glass, 10 to 12 pints, 5s. 6d. each. 17 to 20 pints, 6s. 6d. each.



1410.



1411.



1414.



1415.

413. Bolt Heads, or Globular Flasks, with long cylindrical necks, Fig. 1411, hard glass, very pale green colour.

10 ounce, 3s. per dozen.

15 „ 4s. „

20 „ 5s. „

30 ounce, 6s. per dozen.

40 „ 8s. per dozen.

414. Globular Flask, very short neck, Fig. 1414, hard German glass, for boiling down mineral waters, &c., welted mouth.

8 or 9 inches in diameter, 3s. | 11 or 12 inches in diameter, 4s. 6d.

415. Flasks suitable for the solution of carbonates in acids; namely, for the solution in hydrochloric acid, of fused mixtures of silicates with alkaline carbonates, so formed as to prevent loss by spiriting, form of Fig. 1415, hardest Bohemian glass, the mouth ground, sizes 3 and 6 ounces, *each* 1s. 6d.

416. Glass Parting Flask, or French Matras d'Essai, oval form, long neck, Fig. 1416, white glass.

1 ounce, 1s. 6d. per dozen.

2 ounces, 1s. 6d. „

1416.

3 ounces, 2s. per dozen.

4 and 5 ounces, 2s. 6d. per dozen.

For other forms of Parting Flasks, see article "Assaying."

417. Globular Flask, 2 inches in diameter, with short wide neck, Fig. 1417 or 1419b, very light, of hard thin Bohemian glass, for evaporating solution to dryness, in order to weigh the residue, 3d.

417 a. Ditto, 1 inch bulb, 3d.

418. Very Light Flasks, of hard German glass, blown before the Lamp, form of Figs. 1400 and 1401, thin in glass, globular, with flat bottoms, wide neck, with phial lip, suitable for weighing.

a. Contents, $\frac{1}{2}$ ounce to 1 ounce, 1s. 6d. per dozen.

b. „ $1\frac{1}{2}$ „ to 2 „ 2s.

c. „ $2\frac{1}{2}$ ounces to 3 ounces, 2s. 6d.

d. „ $3\frac{1}{2}$ „ to 4 „ 3s.

Light Flasks with more than one neck are described under the head of "Gas Bottles," or of "Receivers."

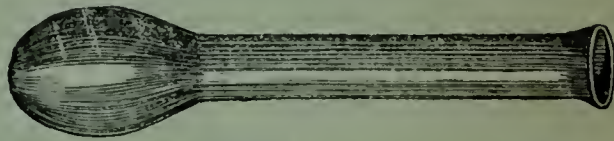


1417.



1419b.

419. BULB BOILING TUBES, of hard German glass, Figs. 1419, a, b, c, the mouth turned over like that of a test tube.



1419a.

PRICE PER DOZEN.

1. Round Bulb, $1\frac{1}{4}$ -inch.	Neck, 2 by $\frac{1}{8}$ inch.	1s. 4d.
2. „ $1\frac{1}{4}$	„ 2 by $\frac{1}{2}$ „	1s. 8d.
3. „ $1\frac{3}{4}$	„ 4 by $\frac{1}{2}$ „	2s.
4. „ 2	„ 3 by $\frac{5}{8}$ „	2s. 3d.
5. Oval Bulb, 2 by $1\frac{1}{3}$ inch.	„ 3 by $\frac{1}{3}$ „	2s. 3d.
6. „ $2\frac{1}{2}$ by $1\frac{3}{4}$ „	„ 7 by $\frac{1}{2}$ „	3s.
7. „ $2\frac{1}{4}$ by $1\frac{1}{2}$ „	„ 4 by $\frac{3}{4}$ „	2s. 6d.
8. „ 2 by $1\frac{1}{2}$ „	„ 3 by $\frac{1}{2}$ „	2s. 3d.
9. „ $2\frac{1}{2}$ by $1\frac{3}{4}$ „	„ 3 by $\frac{1}{2}$ „	2s. 6d.
10. „ $2\frac{3}{4}$ by 2 „	„ 3 by $\frac{5}{8}$ „	3s.
11. „ 3 by $2\frac{1}{4}$ „	„ 3 by $\frac{3}{4}$ „	4s.



1419c.

When an extra neck is supplied to a bulb tube, to convert it into a gas bottle or a receiver, the price is from 1s. to 2s. per dozen higher.

1419*. Boiling Tubes without Bulb, of hard German glass.

Price per Dozen.

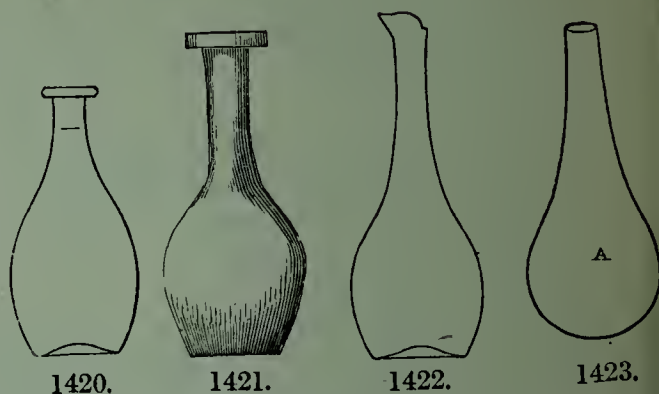
4 inches long, 1 inch wide, 1s. 2d.	7 inches long, 1 inch wide, 1s. 9d.
5 " 1 " 1s. 4d.	7 " 1 $\frac{1}{4}$ " 2s.
5 " 1 $\frac{1}{4}$ " 1s. 7d.	7 " 1 $\frac{1}{2}$ " 2s. 4d.
6 " 1 " 1s. 6d.	8 " 1 " 1s. 10d.
6 " 1 $\frac{1}{4}$ " 1s. 9d.	8 " 1 $\frac{1}{4}$ " 2s. 3d.
6 " 1 $\frac{1}{2}$ " 2s.	8 " 1 $\frac{1}{2}$ " 2s. 8d.

1420. Flasks of Pear-shape, Fig. 1420.

1421. Flasks of oval shape, Fig. 1421.

1422. Flasks with spout, Fig. 1422.

The prices of these flasks are like those of the German flasks, No. 1400, the Bohemian flasks No. 1401, or the French flasks No. 1403, according to the quality of the glass. But flasks of the forms represented by Figs. 1400 and 1401, being now chiefly in demand, are the kinds usually kept in stock.



1420.

1421.

1422.

1423.

1423. Flasks of Infusible Thuringian stoneware, brown colour, form of Fig. 1423 or between that and Fig. 1411.

No.	Contents.		No.	Contents.		No.	Contents.
1.	$\frac{3}{4}$ pint,	3s. each.	5.	4 pints,	6s. each.	9.	10 pints, 11s. each.
2.	1 $\frac{1}{2}$ „	4s.	6.	5 „	7s.	10.	12 „ 14s.
3.	2 $\frac{1}{2}$ „	5s.	7.	6 $\frac{1}{2}$ „	8s.	11.	16 „ 16s.
4.	3 $\frac{1}{2}$ „	5s. 6d.	8.	8 „	9s. 6d.	12.	20 „ 20s.

1424. Flasks of Infusible Hessian Fire-clay, Fig. 1423.

70 ozs., 6s.—90 ozs., 7s.—100 ozs., 8s.—170 ozs., 10s. 6d.

1425. Flasks of Berlin Semi-Porcelain.

2 ounces,	1s. 6d.	8 ounces,	2s. 6d.
4 „	2s.	12 „	3s.

1426. Flasks of Dresden Porcelain, form of Fig. 1423.

No.	Diameter of Bulb.	Contents.
1.	3 inch,	10 ounces, 2s.
2.	4 inch,	20 ounces, 4s.

1427. Cover for Flasks during Digestions, to keep out dirt, and to prevent loss by spirting, thin glass, form of Figure 1427, 1 inch, 1 $\frac{1}{4}$ inch, and 1 $\frac{1}{2}$ inch diameter; per dozen, assorted, 1s. 6d.



1427.

Supports for Flasks with round bottoms. See article "Supports," Nos. 402—405.

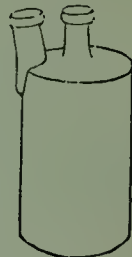
Brushes for cleaning Flasks. See page 15, No. 158.

WOULFF'S BOTTLES.

Woulff's Bottles, for Preparing, Condensing, or Washing Gases, best French make, form of Figs. 1431 and 1432, fine white glass, with well-formed necks, of a size to fit wine corks:—

431. WOULFF'S BOTTLES, WITH TWO NECKS, Fig. 1431.

$\frac{1}{4}$ pint,	10d.	3 pints	1s. 10d.
$\frac{1}{2}$ „	1s.	$3\frac{1}{2}$ „	2s.
$\frac{3}{4}$ „	1s. 2d.	4 „	2s. 3d.
1 „	1s. 3d.	5 „	2s. 6d.
$1\frac{1}{2}$ „	1s. 4d.	6 „	3s.
$1\frac{3}{4}$ „	1s. 6d.	8 „	4s.
2 „	1s. 6d.	10 „	5s.
$2\frac{1}{2}$ „	1s. 8d.		



1431.



1432.

432. WOULFF'S BOTTLES, WITH THREE NECKS, Fig. 1432.

$\frac{1}{4}$ pint,	1s. 6d.	$1\frac{3}{4}$ pint,	2s. 2d.	5 pints,	3s. 6d.
$\frac{1}{2}$ „	1s. 8d.	2 „	2s. 4d.	6 „	4s.
$\frac{3}{4}$ „	1s. 9d.	$2\frac{1}{2}$ „	2s. 6d.	8 „	5s. 6d.
1 „	1s. 10d.	3 „	2s. 9d.	10 „	6s. 6d.
$1\frac{1}{2}$ „	2s.	$3\frac{1}{2}$ „	3s.	20 „	14s.
		4 „	3s. 3d.	30 „	18s.

Woulff's Bottles, fine white German glass, form of the bottles shorter and wider than the French pattern, No. 1431, the necks narrower than those of the French bottles, but all ground inside, and therefore perfectly round.

433. WITH TWO NECKS, Fig. 1433, the necks equidistant from the middle.

$\frac{1}{2}$ pint.	2s.
$\frac{3}{4}$ pint.	2s. 6d.
1 pint.	3s.
$1\frac{3}{4}$ pint.	3s. 6d.



1433.

1434. WITH THREE NECKS, Fig. 1434, the middle neck accurately stoppered.

$\frac{1}{2}$ pint.	2s. 6d.
$\frac{3}{4}$ pint.	3s.
1 pint.	3s. 6d.
$1\frac{3}{4}$ pint.	4s.

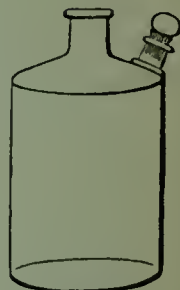


1434.

435. Woulff's Bottles, with a wide neck in the middle and a small neck at the shoulder, the latter stoppered; and the former ground smooth inside, so as to be easily closed by a cork; best white German glass.

1 pint, 3s.		$1\frac{1}{4}$ pint, 3s. 6d.		$3\frac{1}{2}$ pint, 5s.
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Woulff's Bottles, fitted for use as Gas Bottles, are described in the section on *Gas Apparatus*.



1435.

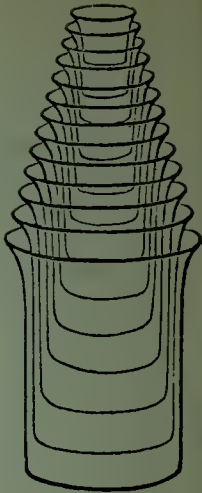
Woulff's Bottles, with a neck at the side near the bottom, are described in the section on *WATER BOTTLES*, at page 23.

BEAKERS.

1440. BERZELIUS'S BEAKER GLASSES, FOR HOT SOLUTIONS, cylindrical form, equally thin at the bottom and sides, with projecting edges, without punty mark at bottom, best hard white Bohemian glass.

Two kinds of Beakers are now manufactured. First, the common Bohemian, or Berzelius, or NARROW form; and secondly, A WIDE form, first introduced by J. J. Griffin. The sizes and capacities of the individual Beakers are stated in the following table; but as no two Beakers can be made *precisely* alike, these measurements are only to be understood as *nearly* or *approximately* accurate.

The Beakers are supplied in nests of from 3 to 15 Beakers in each, as shown by the following Lists.



1440.

1440. TABLE OF THE SIZES OF BEAKERS.

COMMON OR NARROW FORM.				GRIFFIN'S WIDE FORM.			
No.	Height.	Width.	Contents.	No.	Height.	Width.	Contents.
000	1½ inch.	¾ inch.	½ oz.	00	1¾ inch.	1½ inch.	1 oz.
00	2 inch.	1 inch.	1 oz.	0	2 inch.	1½ inch.	1¾ oz.
0	2 inch.	1¼ inch.	1½ oz.	1	2½ inch.	1¾ inch.	3 oz.
1	2½ inch.	1½ inch.	3 oz.	2	3 inch.	2 inch.	5 oz.
2	3 inch.	1¾ inch.	4 oz.	3	3¾ inch.	2½ inch.	8 oz.
3	3¾ inch.	2 inch.	6 oz.	4	4¼ inch.	2¾ inch.	12 oz.
4	4 inch.	2¼ inch.	9 oz.	5	4¾ inch.	3 inch.	18 oz.
5	4¾ inch.	2½ inch.	15 oz.	6	5½ inch.	3½ inch.	27 oz.
6	5¾ inch.	3 inch.	21 oz.	7	6½ inch.	3¾ inch.	40 oz.
7	6¾ inch.	3¼ inch.	33 oz.	8	7¼ inch.	4 inch.	56 oz.
8	7½ inch.	3¾ inch.	48 oz.	9	8½ inch.	4½ inch.	80 oz.
9	8¼ inch.	4 inch.	70 oz.	10	9½ inch.	5 inch.	100 oz.
10	9¼ inch.	4½ inch.	85 oz.	11	10 inch.	5½ inch.	104 oz.
11	10 inch.	5 inch.	110 oz.	12	10 inch.	6 inch.	180 oz.
12	11 inch.	5½ inch.	140 oz.	13	11 inch.	6¾ inch.	220 oz.

1441. PRICES OF BEAKERS IN SETS, USUAL NARROW FORM.

No. of Set.	Beakers in the Set.	Nos. Included.	Contents of Beakers.	Price of the Set.
1441	3	000 to 0	½ oz. to 1½ oz.	7d.
1442	3	0 to 2	1½ oz. to 4 oz.	10d.
1443	3	1 to 3	3 oz. to 6 oz.	1s.
1444	4	5 to 8	15 oz. to 48 oz.	3s. 6d.
1445	6	00 to 4	1 oz. to 9 oz.	2s. 3d.
1446	8	1 to 8	3 oz. to 48 oz.	5s.
1447	8	3 to 10	6 oz. to 85 oz.	6s. 6d.
1448	10	00 to 8	1 oz. to 48 oz.	5s. 6d.
1449	13	00 to 11	1 oz. to 110 oz.	9s. 6d.
1450	14	00 to 12	1 oz. to 140 oz.	10s. 6d.
1451	15	000 to 12	½ oz. to 140 oz.	10s. 9d.

1461. PRICES OF BEAKERS IN SETS. GRIFFIN'S WIDE FORM.

No. of Set.	Beakers in the Set.	Nos. Included.	Contents of Beakers.	Price of the Set.
1461	4	00 to 2	1 Ounce to 5 Ounces	1s. 3d.
1462	4	1 to 4	3 „ to 12 „	1s. 9d.
1463	4	5 to 8	18 „ to 56 „	4s. 6d.
1464	5	0 to 4	1 $\frac{3}{4}$ „ to 12 „	2s.
1465	5	1 to 5	3 „ to 18 „	2s. 6d.
1466	8	00 to 6	1 „ to 27 „	4s.
1467	8	1 to 8	3 „ to 56 „	6s.
1468	8	3 to 10	8 „ to 100 „	8s.
1469	12	00 to 10	1 „ to 100 „	9s.
1470	14	00 to 12	1 „ to 180 „	12s.
1471	15	00 to 13	1 „ to 220 „	13s. 6d.

1480. PRICES OF LARGE BEAKERS, SEPARATELY:—

NARROW FORM.			WIDE FORM.		
No.	Contents.	Price.	No.	Contents.	Price.
8	2 $\frac{1}{2}$ Pints.	1s. 3d.	8	3 Pints.	1s. 4d.
9	3 $\frac{1}{2}$ „	1s. 4d.	9	4 „	1s. 6d.
10	4 $\frac{1}{4}$ „	1s. 6d.	10	5 „	1s. 8d.
11	5 $\frac{1}{2}$ „	1s. 8d.	11	7 „	1s. 10d.
12	7 „	1s. 10d.	12	9 „	2s.
			13	11 „	2s. 3d.

1481. BEAKED TUMBLERS FOR PRECIPITATIONS, GRIFFIN'S PATTERN. Best hard Bohemian glass, same quality as the Bohemian beakers, of uniform thickness throughout, with spouts, Figs. 1481, 1482. The following sizes.

	Deep.	Wide.	Contents.
1.	3 inch.	2 $\frac{1}{4}$ inch.	5 ounces.
2.	3 $\frac{1}{3}$ „	2 $\frac{1}{2}$ „	8 „
3.	4 „	3 „	12 „
4.	4 $\frac{1}{2}$ inch.	3 $\frac{1}{2}$ „	20 „
5.	5 „	3 $\frac{3}{4}$ „	25 „
6.	5 $\frac{1}{2}$ „	4 $\frac{1}{2}$ „	40 „



1485.



1481.



1482.

1482. Price of the set of 6 beakers, Fig. 1482, 4s.

1483. Price of Numbers 1 to 5, 3s.

1484. Price of Numbers 1 to 4, 2s. 4d.

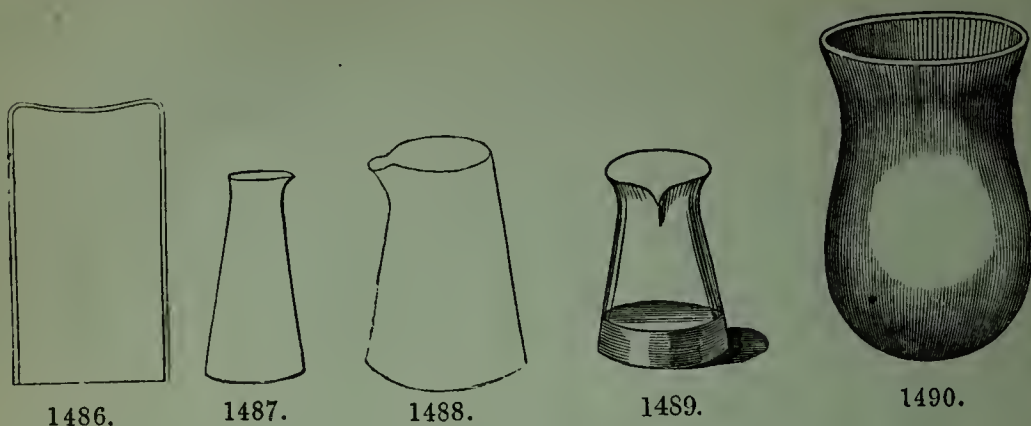
1485. GRIFFIN'S BEAKED TUMBLERS, WITH TWO SPOUTS, Fig. 1485, same sizes and quality as the preceding:—

Set of 4, 3s.

Set of 5, 4s.

Set of 6, 5s.

1486. Cylindrical Jars, flat bottoms, without spout, Fig. 1486, uniformly thin in the glass, from $2\frac{1}{2}$ by $1\frac{1}{2}$ inches to 8 by $4\frac{1}{2}$ inches. See particulars under the head of "Receivers for Gases."



CONICAL BEAKERS.

1487. Conical Precipitating Beakers, of hard Bohemian glass, uniform in substance, form of Fig. 1487, tall and narrow, for hot liquors.

$\frac{1}{4}$ Pint, 8d.	1 Pint, 1s. 3d.	3 Pints, 2s. 6d.
$\frac{1}{2}$ Pint, 10d.	2 Pints, 1s. 9d.	4 pints, 3s.

1488. Conical Precipitating Beakers, German Glass, uniform in substance, thin bottom, Fig. 1488, for hot liquors.

$\frac{1}{4}$ Pint, 6d.	$1\frac{1}{2}$ Pints, 1s.	$4\frac{1}{2}$ Pints, 2s.
$\frac{1}{2}$ Pint, 8d.	3 Pints, 1s. 6d.	9 Pints, 3s.

1489. Conical Mixing Beaker, with a contraction near the mouth, to permit of shaking a liquor by a circular motion without losing any of it, 5 ounce size. 4d.

PORCELAIN BEAKERS AND BOILERS.

1490. Beaker, or Digester, Berlin or Thuringian porcelain, egg-shaped, with wide mouth, glazed within and without, useful in dissolving metals in acids, also as crucibles, a small capsule forming a cover, Fig. 1490.

No. 1.	$2\frac{1}{4}$ by $1\frac{3}{4}$ inch.	Contents, 2 ounce, 7d.
„ 2.	$2\frac{3}{4}$ by $2\frac{1}{4}$ inch.	Contents, 4 ounce, 9d.

- 1490 a. Divided Beaker of Berlin or Thuringian Porcelain, for preparing soda water and other effervescing drinks, from powders, 1s. 6d.

1491. Dresden Porcelain Beakers, glazed within and without, form of Fig. 1491 without spout or rim.

No.	Depth.	Diameter.	Contents.	Price.
1.	4 inch.	4 inch.	15 ounces.	1s. 3d.
2.	$3\frac{1}{4}$ „	$3\frac{1}{4}$ „	10 „	1s.
3.	$2\frac{1}{2}$ „	$2\frac{3}{4}$ „	6 „	8d.
4.	2 „	$2\frac{1}{4}$ „	3 „	6d.
5.	$1\frac{3}{4}$ „	$1\frac{1}{2}$ „	$1\frac{1}{4}$ „	4d.

1492. Price of the nest of Five Beakers, 3s. 6d.

93. Porcelain Digesters, or deep basins, Thuringian porcelain, very thin and light, glazed; can be used for evaporation to dryness, and will bear a red heat. Form of Fig. 1491.

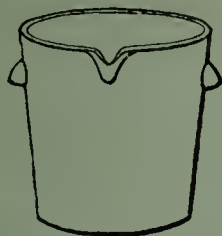
No. 1, 2 inch diameter, 1 in. deep, 1 ounce, 4d.

2, $2\frac{1}{4}$ inch diameter, $2\frac{1}{2}$ inch deep, 3 ounces, 8d.

PORCELAIN BOILERS, for manufacturing purposes. *Not kept in stock, but made to order at the following prices:—*



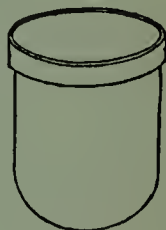
1491.



1494.



1497.



1500.

94. Thuringian porcelain Boilers, form of Fig. 1494, with two ears as handles, 19 inches deep, contents about 12 gallons, £5 5s.

95. Similar, but larger, 22 inches deep, contents about 22 gallons, £9 9s.

96. Similar, but without handles, and smaller, $13\frac{1}{2}$ inches deep, contents about 30 pints, 22s.

97. Thuringian porcelain Boilers, form of Fig. 1497, the following seven sizes:—

	Diameter.	Contents.	Price.		Diameter.	Contents.	Price.
a.	17 inch	2 gallons	12s.	e.	18 inch.	4 gallons.	27s.
b.	17 „	$2\frac{1}{2}$ „	14s.	f.	18 „	5 „	33s.
c.	17 „	3 „	18s.	g.	19 „	6 „	45s.
d.	18 „	$3\frac{1}{2}$ „	23s.				

98. If the boilers, Fig. 1497, are provided with an Iron Handle, the extra price is, For Nos. a, b, c, d, 4s. each. For Nos. e, f, g, 5s. each.

99. If the boilers, Fig. 1497, are covered with Iron Network, but without handles, the extra price is,

For Nos. a, b, c, d, 1s. 6d. each. For Nos. e, f, g, 2s. each.

The method of mounting porcelain vessels with iron handles and iron network, is represented in section on "Evaporation" in the article on Thuringian Porcelain Basins.

100. Berlin Semi-porcelain Boilers, form of Fig. 1500.

	Diameter at mouth, inside.	Depth.	Contents.	Price.
a.	11 inches.	8 inches.	7 quarts.	8s.
b.	13 „	12 „	$3\frac{1}{2}$ gallons.	18s.

DIGESTERS.

Clark's Patent Digesters, cast iron, lined with china, the valves with wire springs.

101. Form of Fig. 1501, 2 pints, 4s. 6d.

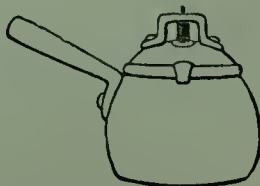
102. Form of Fig. 1501, 4 pints, 5s. 6d.

103. Form of Fig. 1503, 3 pints, 6s. 6d.

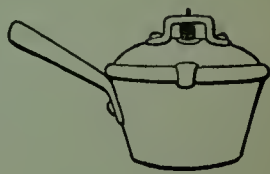
104. Form of Fig. 1504, 8 pints, 8s.

105. Form of Fig. 1504, 10 pints, 10s.

106. Larger sizes of these Digesters can be supplied to order. No. 1501 up to 8 quarts; No. 1503 up to 5 quarts; No. 1504 up to 14 gallons.



1501.



1503.

DIGESTERS OR INFUSION POTS for Pharmaceutical Use.

1507. Digesters or Infusion Pots, Berlin Porcelain, adapted for a Water-bath, with cover, Fig. 1507, and turned wooden handle. *a*, handle or socket for wooden handle; *b*, projection to rest on a water-bath; *c*, section of cover.

No.	Height.	Width.	Contents.	Price.
1.	4½ inch.	2¾ inch.	½ pint	3s. 6d.
2.	5 „	3½ „	1 „	4s. 6d.
3.	7 „	4 „	2 „	6s.

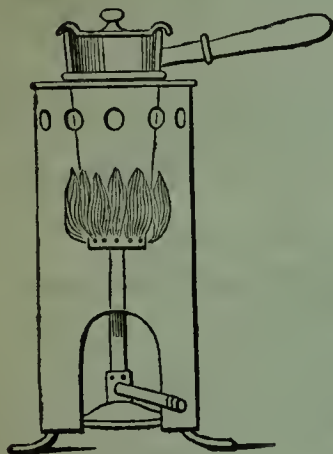
1508. Berlin Porcelain Digesters, as above, mounted on iron-plate furnaces to suit the Rose Gas Burner, No. 973, which may be used without a water-bath Fig. 1508.

No. 1.	Digester and Furnace, 5s. 6d.	} Either of them, with the gas burner No. 973, 2s. 6d. extra.
2.	Digester and Furnace, 7s.	
3.	Digester and Furnace, 9s.	

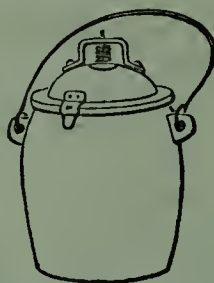
1509. Quick Boiler, for rapidly boiling one or two pints of water, Fig. 1509. The furnace, kettle, and gas burner complete, 10s.

1510. Ditto, the furnace and kettle, without the gas burner, 5s.

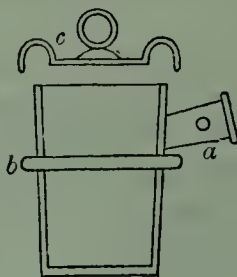
The Gas Burner is No. 974, namely, the Rose Burner, No. 2, price 5s., which, in this case, is used without the rose top, the direct flame applied to metal vessels giving the quickest result; while the safety of the porcelain vessels described at the previous number demands the use of the rose burner. In the Quick Boiler, 1 pint of cold water can be boiled in 5 minutes, and 2 pints in 10 minutes.



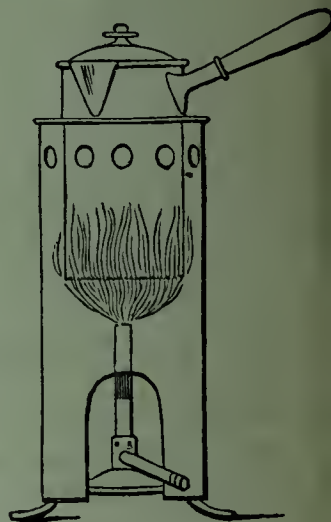
1508.



1504.



1507.



1509.

GLASS JARS WITHOUT FEET.

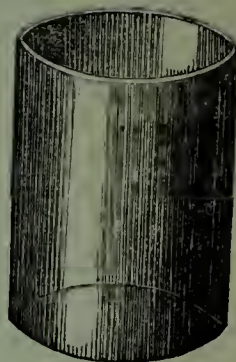
1516. CYLINDRICAL JARS, without foot, flange, or spout, but ground at the mouth, form of Figs. 1516 *a*, *b*, very stout, in glass, for galvanic batteries, for the solution in water of substances that require pressure with a stirrer, or for collecting gases. Hard German Glass.

No.	Diameter.	Height.	Contents (about).	Price.
1516.	3½ inches.	4 inches.	35 ounces.	6d.
1517.	3¾ " "	5 " "	50 " "	9d.
1518.	3¾ " "	5½ " "	55 " "	9d.
1519.	4 " "	6¼ " "	70 " "	1s.
1520.	4½ " "	6¾ " "	95 " "	1s. 3d.
1521.	4 " "	7½ " "	85 " "	1s. 3d.
1522.	4½ " "	8 " "	100 " "	1s. 3d.
1523.	4 " "	8½ " "	90 " "	1s. 3d.

1516 *a*.1516 *b*.

1530. CYLINDRICAL JARS, without feet, vertical sides, flat bottom, without flange or spout, Bohemian glass, stoutly made, the edges cut flat. For cold liquors.

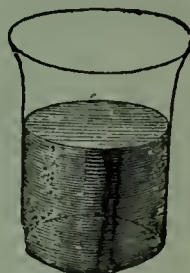
No.	Height.	Diameter.	Contents.	Price.
1.	8 inches.	4 inches.	3 pints.	2s.
2.	9 " "	5 " "	5 " "	3s.
3.	10 " "	6 " "	7 " "	4s.
4.	11 " "	7 " "	10 " "	5s. 6d.
5.	12 " "	8 " "	14 " "	6s. 6d.



1530.

1531. LIXIVIATING JARS, for cold liquors, tall and narrow in the middle so as to be conveniently handled, solid bottom, with spout, Fig. 1531.

1 pint,	8d.	4 pints,	1s. 6d.
1½ " "	10d.	5 " "	1s. 6d.
2 pints,	1s.	6 " "	1s. 9d.
2½ " "	1s. 2d.	7 " "	2s.
3 " "	1s. 4d.		



1532.



1531.

1532. Jar with wide mouth, beaker form, but stout and strong, Bohemian glass, welted mouth, contents 28 pints, Fig. 1532, 10s. 6d.

GLASS JARS WITH FEET.

1533. JARS WITH FEET, cylindrical, with ground edge, not expanded, no spout, hard German or Bohemian glass, Fig. 1533, page 159.

1. 4 inches high, 1 inch wide,	5d.	No. 4. 12 ins. high, 2 in. wide,	1s. 3d.
2. 6 " " 1¼ " "	7d.	5. 16 " " 2½ " "	1s. 6d.
3. 8 " " 1½ " "	10d.	6. 15 " " 4 " "	4s.

JARS WITH FEET, cylindrical, hard German glass, of two kinds, namely :—
 1534. Fig. 1534, with flange at the mouth, no spout, no cover.
 1535. Fig. 1535, with spout and without flange.

Both patterns at the same Price.

Letter c, Fig. 1534 is a glass cover, to close the flanged jar. See "Covers" in the section on
FILTRATION.

The width is taken across the middle, not including the flange.

$1\frac{1}{4}$, $1\frac{1}{2}$, and $1\frac{3}{4}$ INCHES WIDE.

No.	1.	6 inches high,	8d.
	2.	8 "	8d.
	3.	9 "	9d.
	4.	10 "	10d.
	5.	12 "	1s.
	6.	14 "	1s. 2d.
	7.	15 "	1s. 4d.
	8.	16 "	1s. 6d.

2 INCHES WIDE.

	9.	3 inches high,	5d.
	10.	6 "	9d.
	11.	8 "	10d.
	12.	9 "	11d.
	13.	10 "	1s.
	14.	12 "	1s. 2d.
	15.	14 "	1s. 4d.
	16.	15 "	1s. 6d.
	17.	16 "	1s. 8d.
	18.	18 "	2s.

$2\frac{1}{2}$ INCHES WIDE.

	19.	4 inches high,	9d.
	20.	6 "	10d.
	21.	8 "	1s.
	22.	10 "	1s. 2d.
	23.	12 "	1s. 4d.
	24.	14 "	1s. 6d.
	25.	15 "	1s. 9d.
	26.	16 "	2s.

3 INCHES WIDE.

	27.	5 inches high,	1s.
	28.	10 "	1s. 3d.

No. 29. 12 Inches high, 1s. 6d.

	30.	14 "	2s.
	31.	15 "	2s. 3d.
	32.	16 "	2s. 6d.

$3\frac{1}{2}$ INCHES WIDE.

	33.	5 inches high,	1s.
	34.	7 "	1s. 6d.
	35.	14 "	2s. 6d.
	36.	15 "	3s.

4 INCHES WIDE.

	37.	7 inches high,	1s. 9d.
	38.	10 "	2s.
	39.	14 "	3s.
	40.	16 "	3s. 6d.

$4\frac{3}{4}$ INCHES WIDE.

	41.	19 inches high,	4s. 6d.
	42.	12 "	3s. 6d.
	43.	20 "	5s.

5 INCHES WIDE.

	44.	13 inches high,	4s.
	45.	15 "	4s. 6d.
	46.	19 "	5s. 6d.

$5\frac{1}{2}$ INCHES WIDE.

	47.	12 inches high,	5s.
	48.	16 "	6s.
	49.	20 "	8s.

6 INCHES WIDE.

	50.	23 inches high,	9s.
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$6\frac{1}{2}$ INCHES WIDE.

	51.	24 inches high,	10s. 6d.
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8 INCHES WIDE.

	52.	25 inches high,	12s. 6d.
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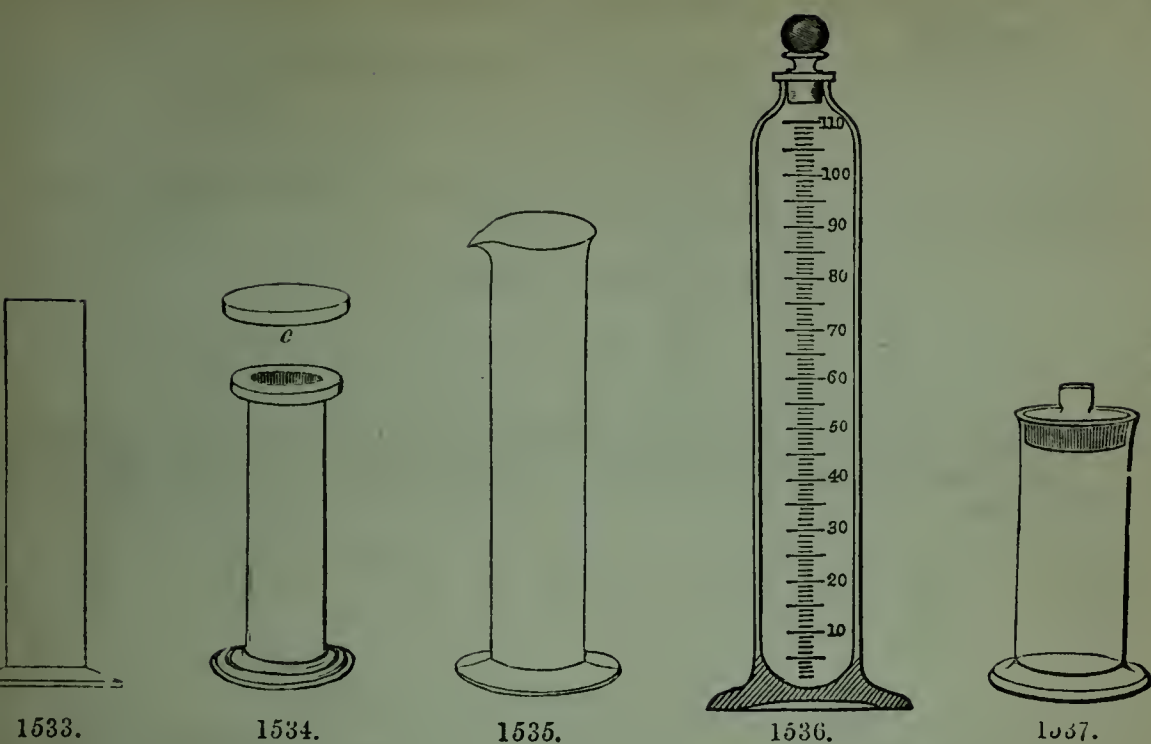
STOPPERED JARS.

1536. Cylindrical Jars on foot, with ground glass stoppers, similar in form to Fig. 1 but not graduated, fine white German Glass.

Approximate measurements, including the foot and flange.

No.	Height.	Diameter.	Price.
1.	$7\frac{1}{2}$ inch.	1 inch.	1s.
2.	$11\frac{1}{2}$ inch.	2 inch.	2s. 6d.
3.	$13\frac{1}{2}$ inch.	1 inch.	1s. 9d.
4.	$13\frac{1}{2}$ inch.	2 inch.	2s. 6d.
5.	$13\frac{1}{2}$ inch.	$2\frac{1}{3}$ inch.	3s.
6.	$13\frac{1}{2}$ inch.	3 inch.	4s.
7.	15 inch.	$3\frac{1}{3}$ inch.	4s.

No.	Height.	Diameter.	Price.
8.	16 inch.	$3\frac{1}{3}$ inch.	5s.
9.	17 inch.	1 inch.	2s.
10.	17 inch.	4 inch.	6s.
11.	18 inch.	$4\frac{1}{3}$ inch.	8s.
12.	19 inch.	$4\frac{3}{4}$ inch.	10s.
13.	23 inch.	4 inch.	9s.



Glass Cylinders on feet, with broad ground stoppers, fine white Bohemian glass, suitable for anatomical and zoological preparations, &c. Fig. 1537.

Width.	Height.	Price.	No.	Width.	Height.	Price.
1 inch.	4 inch.	9d.	14.	4½ inch.	11 inch.	8s.
1½ inch.	6 inch.	1s. 3d.	15.	4½ inch.	15 inch.	10s.
1½ inch.	10 inch.	2s.	16.	5 inch.	18 inch.	15s.
2 inch.	7 inch.	2s. 3d.	17.	5½ inch.	8 inch.	7s.
2½ inch.	5 inch.	2s.	18.	5½ inch.	10 inch.	8s.
2½ inch.	9 inch.	3s. 6d.	19.	6 inch.	18 inch.	20s.
3 inch.	15 inch.	7s.	20.	6½ inch.	10 inch.	12s.
3½ inch.	6 inch.	3s.	21.	6½ inch.	13 inch.	14s.
3½ inch.	8 inch.	4s.	22.	6½ inch.	19 inch.	20s.
3½ inch.	12 inch.	7s.	23.	7½ inch.	15 inch.	21s.
4 inch.	7 inch.	4s.	24.	7½ inch.	19 inch.	25s.
4 inch.	9 inch.	5s.	25.	7½ inch.	24 inch.	38s.
4½ inch.	6 inch.	4s.	26.	10 inch.	18 inch.	36s.

OVAL JARS, on feet, with ground stoppers. *Prepared to order.*

Glass Balls, thin in glass, with glass hooks attached, for suspending zoological and anatomical preparations in jars of spirits, *per dozen*, 1s. 6d.

PANS.

Deep Conical Pans, flat bottoms with spout, saltglaze stoneware, Fig. 1540. Can be heated over a sand-bath or water-bath, suitable for crystallizing pans.

No. 1.	Diameter, 8 inch,	Contents 3 pints,	1s. 3d.
2.	„ 10 „	„ 5 „	1s. 6d.
3.	„ 12 „	„ 8 „	1s. 10d.



1540.

1541. Shallow Conical Pans, saltglaze stoneware, suitable for Dialysers when strength is required.

No. 1.	Diameter 10½ inch,	Contents 8 pints,	2s. 6d.
2.	" 12½ "	" 10 "	3s. 6d.
3.	" 15 "	" 14 "	5s.

1542. Shallow Conical Pans, of pale green glass, suitable for Dialysers, or analytical operations.

No. 1.	Diameter 9 inches,	Contents 6 pints,	2s.
2.	" 11 "	" 8 "	3s.
3.	" 13 "	" 13 "	3s. 6d.
4.	" 15 "	" 16 "	4s. 6d.

1543. Deep Pots for Caustic Liquors, dye-stuffs, &c., form of Fig. 1543, saltglazed stoneware, impervious to colours, acids or alkaline liquors.

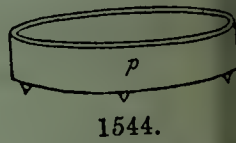
2 pints,	6d.	1 gallon,	1s.	3 gallons,	3s.
3 "	8d.	1½ "	1s. 6d.	4 "	4s.
4 "	9d.	2 "	2s.	6 "	8s.



Other sizes made to order, up to 20 gallons.

1544. Pans of Glazed Earthenware, yellow colour, to place below lamps, basins, &c. also for use as shallow pneumatic troughs, Fig. 1544.

9 inches diameter,	2 inches deep,	with 3 feet,	1s.
12 "	" "	" "	1s. 4d.

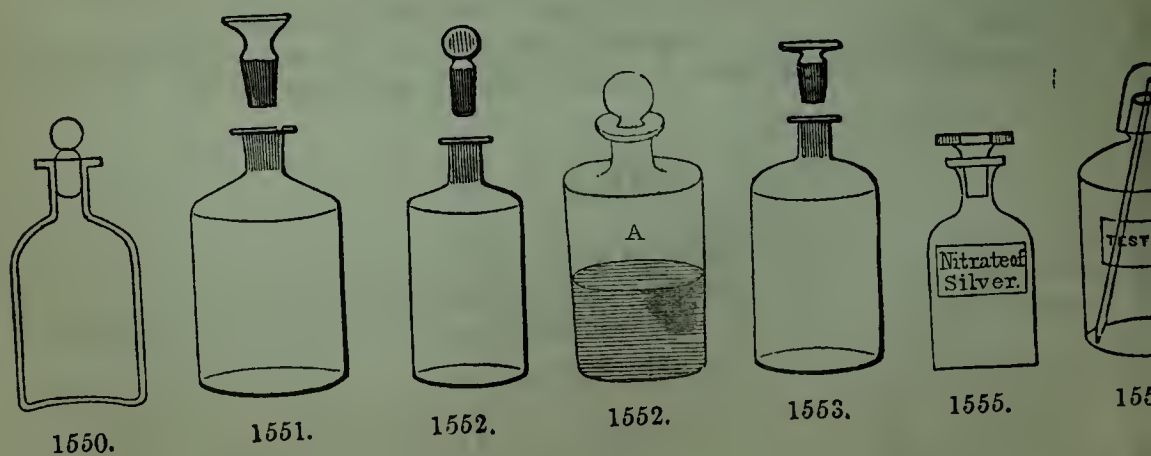


1545. Pail, Berlin semi-porcelain, glazed, with brass handle, 8 inches deep, 8½ inch wide for the lecture table, or experiments on dye-stuffs, 9s.

Bottles for Chemicals.

CLASS I.—BOTTLES WITH NARROW MOUTHS | CLASS II.—BOTTLES WITH WIDE MOUTHS
FOR TEST SOLUTIONS. | FOR DRY CHEMICALS.

Class I.—BOTTLES WITH NARROW MOUTHS.



50. BOTTLES FOR CONTAINING TEST SOLUTIONS, GERMAN GLASS, free from lead, narrow mouths, with ground glass stoppers, Fig. 1550, at *per Dozen*.

$\frac{1}{8}$ ounce, 2s.	3 ounce, 3s.	10 ounce, 5s. 6d.	$1\frac{1}{2}$ pint 9s.
$\frac{1}{4}$ „ 2s.	4 „ 3s. 6d.	12 „ 6s.	2 „ 12s.
$\frac{1}{2}$ „ 2s.	5 „ 3s. 6d.	14 „ 6s. 6d.	$2\frac{1}{2}$ „ 15s.
1 „ 2s. 6d.	6 „ 4s.	16 „ 7s.	3 „ 18s.
$1\frac{1}{2}$ „ 3s.	8 „ 4s. 6d.	18 „ 8s.	4 „ 21s.
2 „ 3s.	9 „ 5s.	1 pint 8s.	5 „ 24s.
$2\frac{1}{2}$ „ 3s.			

51. BOTTLES FOR CONTAINING TEST SOLUTIONS, best white GERMAN GLASS, of hard quality, free from lead, and of a good colour, the lips thin, projecting, and well formed for dropping tests; the stoppers are long and of a conical form, and particularly well ground in, the heads of the stoppers flat, projecting, and sufficiently large to afford a good grip to the fingers; the bottoms of the bottles cut flat. Fig. 1551. *Price per Dozen*.

$\frac{1}{4}$ or $\frac{1}{2}$ ounce, 4s.	4 ounce 10s.	14 ounce, 15s.
1 „ 5s.	6 „ 11s.	20 „ 16s.
2 „ 8s.	10 „ 13s.	27 „ 18s.
3 „ 9s.	12 „ 14s.	35 „ 22s.

52. BOTTLES FOR CONTAINING TEST SOLUTIONS, best FRENCH GLASS, narrow mouths, square shoulders, with long stoppers, well fitted, Fig. 1552, at *per Dozen*.

$\frac{1}{2}$ ounce, 2s. 6d.	2 ounce, 4s.	4 ounce, 5s.	8 ounce, 8s.
1 „ 3s.	3 „ 4s. 6d.	6 „ 6s.	12 „ 10s.

53. BOTTLES FOR CONTAINING TEST SOLUTIONS, best BOHEMIAN GLASS, well fitted, flat headed stoppers, Fig. 1553, at *per Dozen*.

$\frac{1}{2}$ ounce, 4s.	2 ounce, 5s. 6d.	8 ounce, 10s.
1 „ 4s. 6d.	4 „ 6s. 6d.	12 „ 11s.
$1\frac{1}{2}$ „ 5s.	6 „ 9s.	14 „ 12s.

54. Bottles for containing Test Solutions, London made, Flint Glass, Squat Rounds, short necks, and square-headed stoppers, well fitted by grinding. *Price per Dozen*.

$\frac{1}{2}$ ounce, 6s.	3 ounce, 9s.	8 ounce, 14s.
1 „ 6s.	4 „ 10s.	12 „ 16s.
2 „ 8s.	6 „ 12s.	

55. BOTTLES TO CONTAIN ACIDS AND ALKALIES, narrow mouths, German glass, with accurately-ground stoppers, form of Fig. 1551, with white enamel name plates and names in black enamel, in the style of Fig. 1555, two sizes:—

10 ounce, *each bottle*, 2s. 6d. | 20 ounce, *each bottle*, 3s.

The following names:—

1. Sulphuric Acid.	No. 4. Soda.	No. 7. Alcohol.
2. Hydrochloric Acid.	5. Potash.	8. Ether.
3. Nitric Acid.	6. Ammonia.	

56. Bottles for Test Solutions, German glass, with ground caps and pipettes without stoppers, form of Fig. 1556, but without names.

ounce, 6d.	2 ounce, 7d.	4 ounce, 9d.	6 ounce, 1s.
$\frac{1}{2}$ ounce, 6d.	3 ounce, 8d.	5 ounce, 10d.	8 ounce, 1s. 2d.



1557.

1565.

1567.

1568.

1569.

1557. Bottles, with ground stoppers and caps, for Acids and Volatile Re-agents,
1557, Bohemian glass.

1 ounce,	6d.	5 ounce,	1s.	10 ounce,	1s. 6d.
2 "	8d.	6 "	1s. 1d.	15 "	1s. 9d.
3 "	9d.	8 "	1s. 3d.	20 "	2s.
4 "	10d.				

1558. Bottles, with ground stoppers and caps, for retaining volatile re-agents,
white German glass, similar to Fig. 1557, but very accurately ground.

2 ounce, 1s. 6d. | 6 ounce, 2s. | 10 ounce, 2s. 6d.

1559. Acid Bottles, English pale green glass, narrow mouths, well-ground stoppers,
Corbyns and Winchesters.

$\frac{1}{2}$ pint,	5d.	2 pints,	7d.	5 pints,	10d.
1 "	6d.	4 "	9d.		

1560. Shaking Bottle, for mixing water with soap test, &c., well-fitted flat-head
stopper, Fig. 1553, 6 ounces' capacity, 8d.

1561. Opaque Black Glass Bottles (Hyalith), narrow mouths, stoppered:—
4 ounce, 1s. 3d. 8 ounce, 1s. 6d.

1562. Blue Glass Bottles, narrow mouth, 4 ounce, stoppered, 1s.

1563. Caustic Holder, a tube bottle with long hollow stopper, for holding a stick
caustic, 6d.

1564. Bottles of Gutta-percha, with stoppers, for Hydrofluoric Acid.

2 ounce. 4 ounce. 8 ounce. 12 ounce. 16 ounce. 32 ounce.

1565. Stoppered Bottles for Acids, saltglazed stoneware, cased in white ware,
Fig. 1565.

2 quarts, 2s. 6d. 1 gallon, 3s. 2 gallons, 4s.

1566. Acid Jugs, saltglazed stoneware, with spout and handle.

2 pints, 8d. | 3 pints, 1s. | 4 pints, 1s. 2d. | 6 pints, 1s. 4d.

BOTTLES FOR HOLDING PHOTOGRAPHIC COLLODION, fine German glass.

1567. Contents 4 ounces, with ground cap, Fig. 1567, 2s. 6d.

1568. Contents 3 ounces, with cap, funnel-shaped mouth, and spout, all ground
fit, Fig. 1568, 2s. 6d.

This bottle can be used to supply small quantities of acid. Any liquor that flows over the
is caught by the funnel, and descends into the bottle by a groove cut in the ground part
spout.

9. Contents of bottle, 5 ounces, of the tubular funnel, 7 ounces, with flat cut glass stopper, all ground to fit, Fig. 1569, 3s. 6d.

The globular funnel is intended to hold cotton for the filtration of the collodion when returned to bottle.

TEST BOTTLES, labelled for the various re-agents, supplied in sets, either with or without CABINETS.

1. Bottle Caps, flexible vulcanized caoutchouc, price according to diameter.

$\frac{3}{4}$ inch,	2d.	$1\frac{1}{4}$ inch,	3d.	2 inch,	6d.
1 „	$2\frac{1}{2}$ d.	$1\frac{1}{2}$ „	4d.	$2\frac{1}{2}$ „	8d.

Class II.—BOTTLES WITH WIDE MOUTHS.

5. Bottles for containing Chemicals in the solid state, white French glass, Fig. 1575, wide mouths, without stoppers, intended for corking. *Price per Dozen :—*

$\frac{1}{2}$ ounce,	1s.	6 ounce	2s. 6d.	$1\frac{1}{2}$ pint,	7s.
$\frac{3}{4}$ „	1s. 1d.	7 „	2s. 9d.	$1\frac{3}{4}$ „	7s. 6d.
1 „	1s. 2d.	8 „	3s.	2 „	8s. 6d.
$1\frac{1}{2}$ „	1s. 3d.	9 „	3s. 3d.	$2\frac{1}{2}$ „	10s.
2 „	1s. 4d.	10 „	3s. 6d.	3 „	12s.
$2\frac{1}{2}$ „	1s. 6d.	12 „	4s.	$3\frac{1}{2}$ „	14s.
3 „	1s. 7d.	14 „	4s. 6d.	4 „	17s.
$3\frac{1}{2}$ „	1s. 8d.	16 „	5s.	5 „	21s.
4 „	1s. 9d.	18 „	5s. 3d.	6 „	25s.
$4\frac{1}{2}$ „	1s. 10d.	1 pint,	5s. 6d.	8 „	30s.
5 „	2s.	$1\frac{1}{4}$ „	6s. 3d.		

6. Powder Bottles for containing chemicals in the solid state, German glass, wide mouths, ground glass stoppers with square heads, Fig. 1576, *at per Dozen :—*

$\frac{1}{4}$ ounce,	2s. 6d.	5 ounces,	6s.	1 pint,	12s.
$\frac{1}{2}$ „	3s.	6 „	7s.	$1\frac{1}{4}$ „	13s. 6d.
$\frac{3}{4}$ „	3s. 6d.	7 „	7s.	$1\frac{1}{2}$ „	15s.
1 „	4s.	8 „	7s. 6d.	2 „	18s.
$1\frac{1}{2}$ „	4s.	10 „	8s.	3 „	21s.
2 „	4s. 6d.	12 „	8s. 6d.	4 „	24s.
$2\frac{1}{2}$ „	4s. 6d.	14 „	9s.	5 „	30s.
3 „	5s.	16 „	10s.	6 „	36s.
4 „	5s. 6d.				

7. Bottles for containing Chemicals in the solid form, wide mouths, best hard white German glass, similar to the solution bottles, No. 1551, and the stoppers of the form shown by that Figure; conical below, flat above, with a strong neck, the grinding very accurate, Fig. 1577. *Price per Dozen :—*

$\frac{1}{2}$ ounce,	5s.	4 ounce,	10s.	20 ounce,	18s.
1 „	6s.	6 „	12s.	35 „	24s.
2 „	8s.	10 „	15s.		

1578. Bottles for containing Chemicals in the solid form, fine French glass, square shouldered, wide mouths, with long stoppers, well ground, Fig. 1578.

Price per Dozen:—

1 ounce,	7s.	4 ounce,	10s.	8 ounce,	12s.
2 „	8s.	6 „	11s.	10 „	13s.

1579. Bottles of hard white Bohemian glass, extremely wide necks, with glass stoppers, ground, but not air-tight. Fig. 1579.

$\frac{1}{2}$ pint, each	7d.	3 pints,	1s. 4d.	12 pints,	3s.
1 „	9d.	4 „	1s. 8d.	15 „	4s.
$1\frac{1}{2}$ „	10d.	6 „	2s.	18 „	5s.
2 „	1s.	8 „	2s. 4d.	20 „	5s. 6d.
$2\frac{1}{2}$ „	1s. 2d.	10 „	2s. 8d.	24 „	6s.



1575.



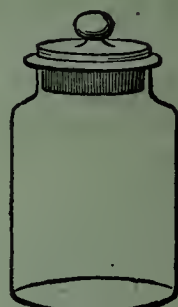
1576.



1577.



1578.



1579.



1580.

1580. Reversed Bottles for Exhibiting Chemical Preparations in Museums, flat glass stoppers, Fig. 1580, fine Bohemian glass.

$\frac{1}{4}$ pint,	1s.	$\frac{3}{4}$ pint,	1s. 6d.	2 pints,	2s. 6d.
$\frac{1}{2}$ „	1s. 3d.	1 „	2s.	3 „	4s.

1581. London made Flint Glass Bottles, for Dry Chemicals, wide mouths, with square-headed stoppers, well ground. *Price per Dozen:—*

1 ounce,	7s.	4 ounce,	11s.	8 ounce,	15s.
2 „	9s.	6 „	13s.	12 „	17s.

1582. Bottle for Powders, very wide mouth, hollow glass spherical stopper, ground but not air tight, 6 ounce size, per dozen, Fig. 1582, 3s.

1583. Opaque Black Glass Bottles (Hyalith), German, wide mouths, flat stoppers.

2 ounce, 1s. 6d. 4 ounce, 1s. 9d. each.



1582



1584.

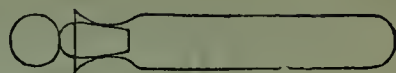
SPECIMEN BOTTLES.

1584. Bottles with wide mouths and flat-headed stoppers, made of slight glass, blown before the lamp, and adapted for small quantities of chemicals, fitted to form part of blowpipe and micro-chemical cabinets. Fig. 1584.

$\frac{1}{4}$ ounce, 2d. $\frac{1}{2}$ ounce, 3d. $\frac{3}{4}$ ounce, $3\frac{1}{2}$ d. each.

88. BOTTLES MADE OF GLASS TUBE, with contracted necks and bordered mouths, for corks or stoppers :—

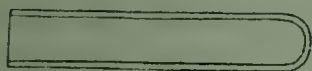
- No. 1. Bottle, $1\frac{1}{2}$ inch by $\frac{1}{4}$ inch, per dozen, 8d.
 2. Bottle with ground stopper, per dozen, 1s. 9d.
 3. Bottle, 2 inch by $\frac{1}{2}$ inch, per dozen, 1s.
 4. Bottle with ground stopper, per dozen, 2s.
 5. Bottle, $1\frac{1}{2}$ inch by $\frac{3}{8}$ inch, per dozen, 6d.
 6. Bottle, $2\frac{1}{4}$ inch by $\frac{7}{16}$ inch, narrow neck, globular stopper, per dozen, 3s.
 7. Bottle, 3 inch by $\frac{5}{8}$ inch, narrow neck, globular stopper, per dozen, 3s. 6d.
 8. Bottle, $1\frac{1}{4}$ inch by $\frac{7}{16}$ inch, with cut glass stoppers, per dozen, 2s. 6d.



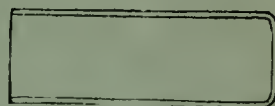
1588.

89. PLAIN TUBE BOTTLES, of stout white German glass, mouths not expanded, but fused smooth; serving to contain specimens of chemicals, or to collect small quantities of gas over mercury.

ROUND Bottoms, Fig. 1589, or FLAT Bottoms, Fig. 1590, *at the same price.*



1589.



1590.

LENGTH of the Tubes in INCHES.	DIAMETER of the Tubes in INCHES, and PRICE <i>per Dozen.</i>								
	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$
inch.	6d.	8d.	9d.	1s.	1s. 3d.	—	—	—	—
inch.	6d.	8d.	10d.	1s. 2d.	1s. 6d.	—	—	—	—
inch.	—	8d.	10d.	1s. 3d.	1s. 7d.	2s.	2s. 3d.	—	—
inch.	—	10d.	1s. 1d.	1s. 4d.	1s. 9d.	2s. 3d.	2s. 9d.	—	—
inch.	—	—	1s. 3d.	1s. 6d.	1s. 10d.	2s. 4d.	3s.	3s. 6d.	3s. 9d.
inch.	—	—	1s. 6d.	1s. 9d.	2s.	2s. 6d.	3s. 3d.	3s. 9d.	4s. 3d.
inch.	—	—	1s. 8d.	2s.	2s. 3d.	2s. 9d.	3s. 6d.	4s. 3d.	5s.

91. Tube Bottles of German glass, with wide mouths and ground glass stoppers.
 ROUND Bottoms and FLAT Bottoms, *at the same price.*

LENGTH of the Tubes in INCHES.	DIAMETER of the Bottles in INCHES, and PRICE <i>per Dozen.</i>					
	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1
2 inches.	1s. 9d.	2s.	2s. 3d.	2s. 6d.	—	—
3 inches.	—	2s.	2s. 3d.	2s. 6d.	2s. 9d.	—
4 inches.	—	—	2s. 6d.	2s. 9d.	3s.	3s. 3d.
5 inches.	—	—	2s. 9d.	3s.	3s. 3d.	3s. 9d.
6 inches.	—	—	3s.	3s. 3d.	3s. 6d.	4s.

Chemical Labels.

1592. A SERIES OF SIX HUNDRED CHEMICAL LABELS printed to the annexed pattern comprehending the names of all the Re-agent used in Analysis, the Photographic Chemicals and most other substances employed by the Experimental Chemist, arranged in alphabetical order. *Gummed ready for use, 6d.*

**Barium
Chloride.**

1593. A SERIES OF CHEMICAL LABELS, 500 in number, comprising the names of the TESTS USED IN ANALYSIS, including all the Tests recommended by Rose, Berzelius, Fresenius, Wackenroder, Graham, Hofmann, Parnell, &c., also of other Chemical Preparations in general use, printed according to the annexed pattern. Gummed ready for immediate use, and bound in order in a book. The set, 1s. 6d.

**MAGNESIA
Sulphate.**

1594. DE LA RUE'S (WARREN) CHEMICAL LABEL BOOK; Imperial 4to containing 644 LABELS OF ELEMENTARY AND COMPOUND BODIES, systematical arranged. Each label contains the Symbol of the Compound, and the Atomic Weight according to Berzelius, Brande, and Liebig. Printed according to the following pattern on fine glazed paper, 4d.

BI CHLORIDE MERCURY

symb. Hg Cl_2

Eq. Liebig 272.84

Brande 272

Berzelius 136.9, 2 Eq. 273.8

Filtration, Percolation, Edulcoration.

FUNNELS.

595. GLASS FUNNELS FOR FILTRATION, form of Fig. 1595, the sides inclined at an angle of 60° , and the vertical section being an equilateral triangle, which adapts them to the shape of a plain paper filter; German glass, the following sizes :

Diameter.	Price.	Diameter.	Price.	Diameter.	Price.
1 inch,	1½d.	3 inch,	3d.	8 inch,	1s. 6d.
1¼ "	1½d.	4 "	4d.	9 "	1s. 9d.
1½ "	1½d.	5 "	6d.	10 "	2s.
2 "	2d.	6 "	9d.	11 "	
2½ "	2½d.	7 "	1s. 2d.	12 "	

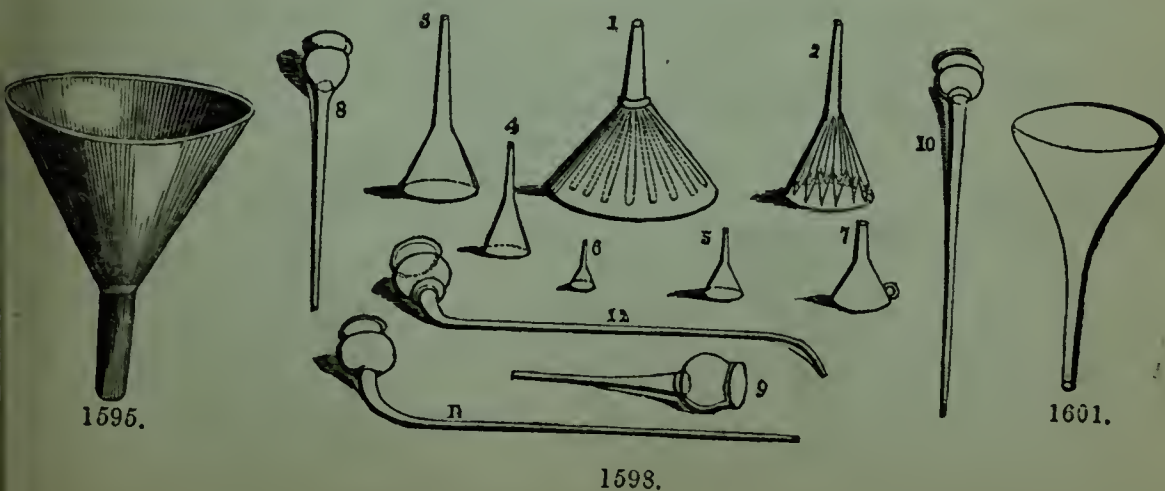
596. Glass Funnel, ground on the edges so as to be closed air-tight by glass covers (see Covers, No. 1677), are charged extra, for each funnel, as follows :
1 to 4 inch, 1d. 5 to 7 inch, 2d. 8 to 10 inch, 3d.

597. Glass Funnel of 60° , for filtration, of stout Bohemian glass, with the top edge and the end of the neck ground :—

1 inch,	3d.	3½ inch,	7d.	7 inch,	1s. 8d.
1½ "	4d.	4 "	8d.	8 "	2s.
2 "	5d.	4½ "	10d.	9 "	2s. 6d.
2½ "	6d.	5 "	1s.	10 "	3s.
3 "	6d.	6 "	1s. 4d.		

598. Glass Funnel, French form, long and narrow sides, forming an angle of about 40° . These funnels are well suited for fillers, but do not hold filters conveniently, unless the papers are folded as represented by Fig. 1598, No. 2.

1 to 4 ounce,	2d.	12 ounce,	4½d.	1½ pint	8d.
5 to 7 "	2½d.	16 "	5d.	2 "	10d.
8 "	3d.	1 pint,	6d.		



1599. Glass Funnel, deeply ribbed, No. 1, Fig. 1598, angle of 60° , useful for rapid filtration when the insoluble matter is not required.

2 inch diameter, 3d.	4 inch diameter, 6d.
2½ " 4d.	5 " 8d.
3 " 5d.	6 " 10d.

1600. Funnel, slight, blown glass, form nearly of 60° , $\frac{1}{2}$ inch to 1 inch wide, with narrow necks; very light, intended to rest on test tubes, or for pouring mercury into narrow vessels, &c., Fig. 1598, Nos 4, 5, 6; *per set of three*, 4d.

1601. Funnel, slight blown glass, $1\frac{1}{2}$ -inch diameter, suitable for filtrations into tubes, Fig. 1601, 2d.

1602. Filter Hooks, to facilitate filtration, and prevent the bursting of paper filters when loaded with a precipitate, Fig. 1602, the hooks 5, 6, 7, or 8 inches long, *per dozen*, 1s. 6d.

When it is desired to filter a liquid rapidly, and a ribbed filter is not at hand, or when using a large funnel, or one that is too wide at the part where the cone joins the tube, it is desired to strengthen the paper, it is advisable to arm the funnel with three glass rods, bent and arranged as shown by Fig. 1602. This plan not only facilitates the filtration of the liquid, but supports the filter at the bottom, and prevents its bursting under the weight of the superincumbent liquid or precipitate.



1602.

BERLIN SEMI-PORCELAIN FUNNELS.

1603. Plain Funnel, or Filler, useful also for filtering, being formed at an angle of 60° , Fig. 1603.

No. 00. 2-inch, 6d.	No. 2. $4\frac{1}{2}$ -inch, 1s. 6d.
0. $3\frac{1}{2}$ " 1s.	3. 5 " 2s.
1. 4 " 1s. 6d.	4. 6 " 2s. 6d.



1603.

1604. Ribbed Funnel, without necks, Fig. 1604.

No. 1. 3-inch, 8d.	No. 2. 4-inch, 1s.
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1605. Ribbed Funnel, with neck, Fig. 1605.

No. 0. $3\frac{1}{2}$ -inch, 1s. 6d.	No. 4. 6-inch, 3s. 6d.
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1604.

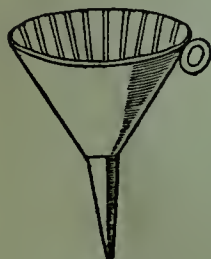
1606. Pierced Funnel, for Rapid Filtration, with cloth filters, Figs. 1606.

No. 2. $5\frac{1}{2}$ -inch, 2s. 3d.	No. 3. 7-inch, 3s.	No. 4. $7\frac{1}{2}$ -inch, 3s. 9d.
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1607. Ribbed Funnel, without neck, the lower part pierced with holes, with flange or collar to rest on a jar, Fig. 1607.

No. 1. $4\frac{1}{2}$ -inch, 2s. 3d.	No. 2. $6\frac{1}{4}$ -inch, 2s. 9d.
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1608. Ribbed Funnel, without neck, the lower part pierced with holes, similar Fig. 1607, but without the collar, 2-inch, 8d.



1605.



1606.



1606.



1607.



1609.

9. **BERLIN PORCELAIN FUNNELS**, for filtrating through cloth, form of Fig. 1609, white glazed.

	Deep.	Wide.	Price.		Deep.	Wide.	Price.
No. 00.	4 $\frac{1}{4}$ -inch.	4 inch.	11d.	No. 2.	7 inch.	6-inch.	2s. 4d.
0.	5 „	4 $\frac{1}{4}$ „	1s. 4d.	3.	7 $\frac{1}{2}$ „	6 $\frac{1}{2}$ „	3s. 3d.
1.	6 „	5 „	1s. 8d.	4.	8 $\frac{1}{2}$ „	7 $\frac{1}{2}$ „	4s.

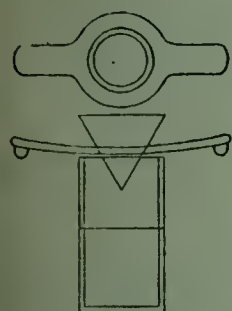
FUNNEL HOLDERS. (See page 33.)

FILTRATION WITHOUT FUNNELS.

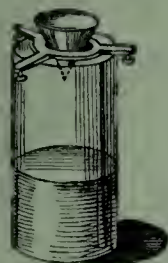
Filter Ring, for supporting a Paper Filter over a Solution Jar, without the help of a funnel; useful in rapid filtration, when the liquid alone is required; it has two flat horizontal arms to rest on the Solution Jar, yellow glazed china, Fig. 1610.

Ring, 1 $\frac{1}{4}$ -inch diameter, 3d.

Ring, 1 $\frac{1}{2}$ -inch diameter, 3d.



1610.



1611.



1611.



1612.

a. The same Filter Ring, in white glazed Berlin porcelain, 5d.

b. Ditto Wedgwood's, 4d.

. Filter Ring, white glazed Berlin porcelain, with three arms, Fig. 1611, 10d.

a. Ditto Wedgwood's, 6d.

b. Ditto, large size, 8d.

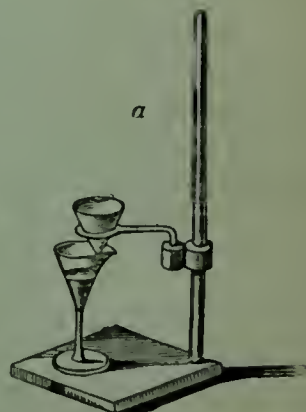
10. **HOLDER FOR GLASS FILTER RINGS**, by which a Filter is held without a funnel, in such a manner that the point of the filter is made to touch the inner surface of the receiving jar, so as to ensure effectual draining, Fig. 1612. In mahogany, French polished, 3s.

There are two moveable blocks by which the height of the solution can be adjusted to agree with the point of the filter.

11. **Glass Ring with flat handle**, adapted to this support, from $\frac{3}{4}$ -inch to 1 $\frac{1}{4}$ -inch diameter, per dozen, 3s.; singly, 4d.

12. **HOLDER FOR GLASS FILTER RINGS**, consisting of a double cylinder of japanned tinplate fitted with corks, one of which slides on an upright rod, while the other is perforated to receive the bent handle of the Glass Ring, Fig. 1614, the rod and foot of polished black wood, 1s.

13. **Glass Ring, with bent handle**, Ring $\frac{3}{4}$ -inch diameter, 2d.; 1-inch diameter, 2d.



1614.

1616. Glass Slips, for the filtration of small quantities of liquid in qualitative analysis, as shown by Fig. 1616.
 6-inch by 1-inch, per dozen, 4d. | 4-inch by $\frac{5}{8}$ -inch, per dozen, 3d.
 5-inch by $\frac{3}{4}$ -inch, per dozen, 3d. |

QUICK FILTERS.

1617. BEALE'S QUICK FILTER, for use in Centigrade Testing, Fig. 1617, 1s.

This is used to filter off a small quantity of a solution, to test for sulphates or other substances in solution. A bit of filter paper and muslin is tied over the end *a*. The bottom is dipped into the turbid liquor, and the filtered liquor, which rises in the tube *b*, is decanted from the spout *c*, into a test glass for trial.

1618. BERZELIUS'S QUICK FILTER FOR LARGE QUANTITIES OF LIQUID, Fig. 1618, Bohemian glass.

5 inches diameter, 10s.
 6 inches diameter, 10s. 6d.

This apparatus is filled with the liquid that is to be filtered, and is fixed over the filter in such a manner that the point of the funnel Fig. 1618, is one-tenth of an inch below the edge of the paper filter; the stopcock is then to be opened, upon which the filter becomes filled, and the filtration goes on till the angular funnel is empty, air entering through its lower tube and stopcock as the liquor runs down. The bore of the stopcock must be about $\frac{2}{3}$ -inch, to allow sufficient passage for the air and water. The vessel when empty is refilled the stopcock being closed while the liquid is inserted by the upper neck. At the end of the process any precipitate which adheres to the inner surface of the vessel, is carefully rubbed off with a feather.



1618.



1617.



1616.

FILTRATIONS IN ANALYSIS.

1619. ENGLISH FILTERING PAPER, of the best quality, in square sheet measuring 24 inches by 24 inches, per quire of 24 sheets, 1s. 6d.

CUT FILTERS, seven sizes, in packets of 100, according to the table at page 17.

This FILTERING PAPER is prepared with the greatest care, and can be recommended for its great purity and property of rapid filtration. It contains no matter soluble in water, and its ashes amount to only 1 part in 240.

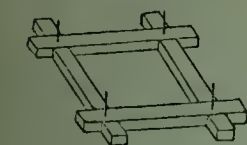
1620. FILTERING PAPER of the same quality and size as the above, but STRONGER, namely, one third thicker in substance; for the formation of large filters or for the filtration of substances that are liable to pass through the paper per quire of 24 sheets, 2s.

1621. SWEDISH FILTERING PAPER, size of the sheets 21 inches by 17 inches per quire of 24 sheets, 3s.

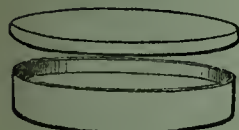
1622. Swedish Filtering Paper, cut into circular filters, in packets of 100, at the following prices:—

No.	Size	for a	1 -inch Funnel,	per packet,	
0.	2 -inch,				4d.
1.	$2\frac{1}{4}$ -inch,	"	$1\frac{1}{4}$ -inch	"	5d.
2.	$2\frac{3}{4}$ -inch,	"	$1\frac{1}{2}$ -inch	"	8d.
3.	$3\frac{3}{4}$ -inch,	"	2 -inch	"	1s.
4.	$4\frac{1}{2}$ -inch,	"	$2\frac{1}{2}$ -inch	"	1s. 2d.
5.	$5\frac{1}{2}$ -inch,	"	3 -inch	"	1s. 8d.
6.	$7\frac{1}{2}$ inch,	"	4 -inch	"	2s. 3d.

1623. Swedish Filters, seven sizes, one packet, 100 filters, of each size, 7s. 6d.
 1624. Grey Woollen Filtering Paper for tinctures, very stout, in sheets measuring 24 inches by 24 inches, per quire of 24 sheets, weighing about $2\frac{1}{2}$ lbs., 3s.
 1625. Filtering Frame, for supporting a linen or woollen cloth filter, Fig. 1625; Plate Glass, with German silver pins, 10 inches diameter, 10s.



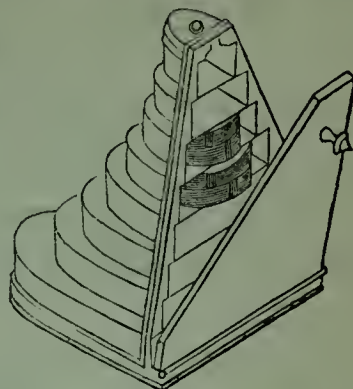
1625.



1628.



1627.



1629.

GLASS FUNNELS FOR FILTRATION, superior circular ENGLISH FILTER-PAPERS, in packets of 100, and JAPANNED BOXES for the filters, each box able to contain 200 papers.

626. The following table embraces the seven sizes most commonly used in Analytical Operations:—

Nos.	FUNNELS.		FILTERS AT PER 100.		FILTER BOXES.
	Diameter.	Price.	Diameter.	Price.	Price.
0	1-inch	$1\frac{1}{2}$ d.	2-inch	2d.	4d.
1	$1\frac{1}{4}$ -inch	$1\frac{1}{2}$ d.	$2\frac{1}{4}$ -inch	2d.	4d.
2	$1\frac{1}{2}$ -inch	$1\frac{1}{2}$ d.	$2\frac{3}{4}$ -inch	$3\frac{1}{2}$ d.	5d.
3	2-inch	2d.	$3\frac{3}{4}$ -inch	5d.	6d.
4	$2\frac{1}{2}$ -inch	$2\frac{1}{2}$ d.	$4\frac{1}{2}$ -inch	6d.	7d.
5	3-inch	3d.	$5\frac{1}{2}$ -inch	9d.	9d.
6	4-inch	4d.	$7\frac{1}{2}$ -inch	1s.	1s.

27. The set of seven Glass Funnel, Fig. 1627, 1s. 4d.
 28. The set of seven round japanned tin boxes, with 100 filters in each, 7s.
 The FILTER BOXES are made of Japanned tinplate, round, with lift-off covers, so that the filters easily kept clean and ready for immediate use; each box will hold 200 filters. Fig. 1628.
 29. Pyramid Filter Case, Fig. 1629, of japanned tinplate, with hinged door closing with a spring, containing 700 filters, namely, 100 of each size, Nos. 0 to 6, 12s. Price of the filter case without filters, 9s.
 30. Donovan's Apparatus for the Filtration of solutions of Caustic Potash, by which the filtration is made without any change of atmospheric air, and therefore without the continuous absorption of carbonic acid, funnel 4 inch diameter, receiving bottle $1\frac{1}{2}$ to 2 pints, German glass, with stopper and caoutchouc connector, Fig. 1630, page 172, 6s.

FILTRATION OF BOILING LIQUIDS.

1. Apparatus for Filtration, at 212° Fahr., consisting of a water-bath of japanned tin, as described at No. 1255, having a space for a 5-inch funnel of 60° , Fig. 1631, page 172, 12s.
 2. Ditto, with a 5-inch funnel, ground edge, and a 6-inch ground glass plate, 13s

1633. Hot-water Funnel, after Plantamour, with side tube for boiling the water so as to filter at 212° Fahr., Fig. 1633.

	Single Funnel.	Double Funnel.
a. Tinplate, for a 4-inch Funnel	3s.	4s.
b. " " 6-inch "	3s. 6d.	5s.
c. Copper, " 4-inch "	5s.	6s. 6d.
d. " " 6-inch "	6s. 6d.	9s.

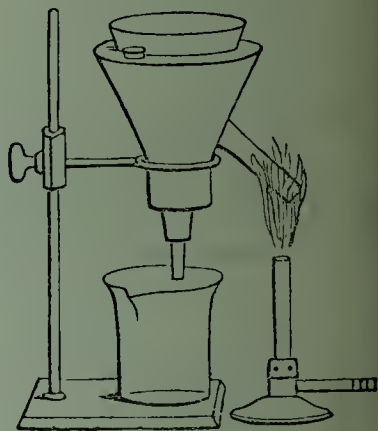
This apparatus is made of two kinds: the first, made according to Plantamour, is simply an outer metal case, in which the glass funnel is fixed by a cork at the neck. The second kind is a double metal funnel, holding the water in an enclosed space, the glass funnel being placed inside the double funnel, but not in contact with the water. The first kind gives the greatest heat to the filter. The second kind permits the ready changing of the funnel, but does not heat the filter so strongly as the first kind. The prices quoted are for the metal funnels only, without the other articles represented in Fig. 1633. The tinplate funnels are jappanned.



1630.



1631.



1633.

PERCOLATORS AND SEPARATORY FUNNELS.

1635. Funnels, German glass, angle of 60° , with glass stopcocks, Fig. 1636.
3-inch, 4s. 6d. | 4-inch, 5s. | 5-inch, 5s. 6d. | 6-inch, 6s.

Covers for Funnels, circular glass plates. See No. 1677.

1636. Funnels, fine white Bohemian glass, with cut glass stopcock, Fig. 1636.

4-inch, 6s. 6d.	6-inch, 8s.	8-inch, 10s.
5-inch, 7s.	7-inch, 9s.	9-inch, 12s.

1637. Funnels, fine white Bohemian glass, with cover and groove for a water lute with neck and cut stopper, Fig. 1637, 5 inches diameter, 3s. 6d.

1638. Funnel, fine white Bohemian glass, with cover and water lute, ground stopper and stopcock, cut glass, Fig. 1638, 5 inches diameter, 9s.

1639. Funnel, fine white Bohemian glass, with cover and groove for a water lute, two necks with ground stoppers, and a stopcock, Fig. 1639, 5 inches diameter, 10s. 6d.

1640. Separatory Funnel, spindle form, Fig. 1640, German glass, stoppered, 2s.

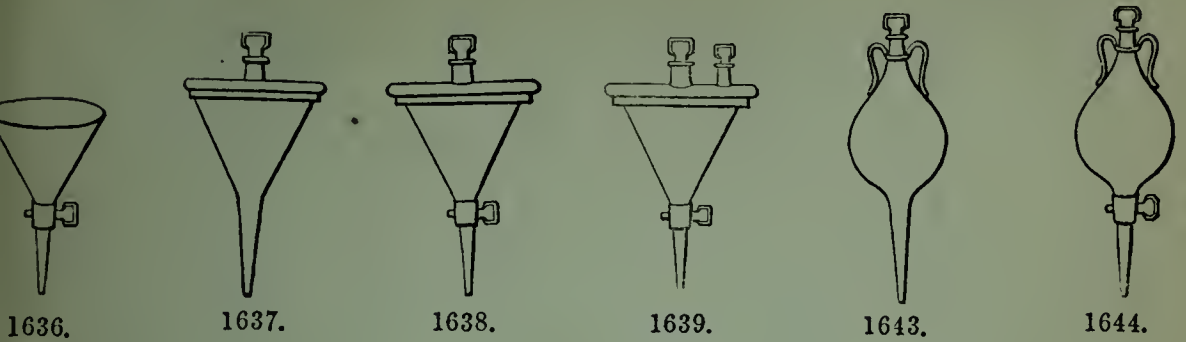
1641. Separatory Funnel, with stopcock, form of Fig. 1641, small size, funnel 1 inches wide, tube 12 inches long, 2s.

1642. Separatory Funnel, with globular head, stopper and stopcock, Fig. 1642, bulb 2 inches wide, tube 12 inches long, 2s. 6d.

Figs. 1640, 1641, 1642, are on page 174.

13. Separatory Funnel, fine Bohemian glass, with stoppered neck, and two arms, Fig. 1643. Price according to the diameter of the body:—

3-inch, 2s. | 4-inch, 2s. 6d. | 5-inch, 3s. 6d. | 8-inch, 4s. 6d.



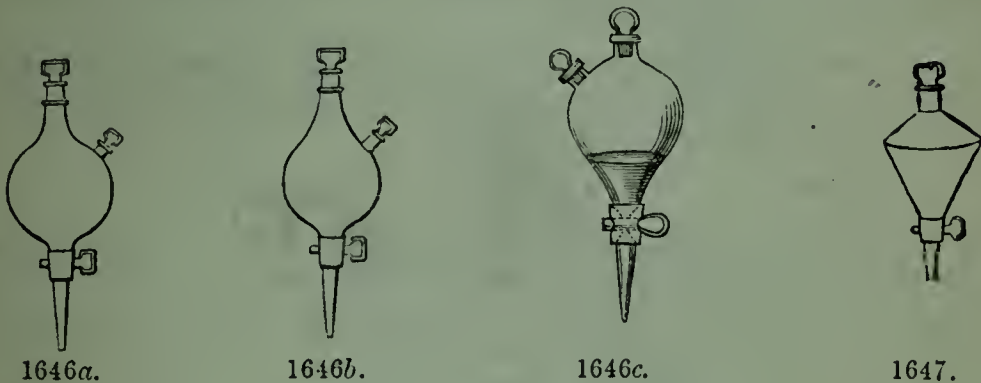
14. Separatory Funnel, fine Bohemian glass, with stoppered neck, two arms, and a glass stopcock, Fig. 1644.

3-inch, 8s. | 4-inch, 9s. | 5-inch, 10s. | 8-inch, 11s.

15. Separatory Funnel, German glass, globular form, 4 inches diameter, 36 ounces capacity, with stopper in the neck, and stopcock on the neck, form of Fig. 1644, without the arms, 6s.

16. Separatory Funnel, fine white Bohemian glass, globular form, with two necks, stoppered, and a glass stopcock, Fig. 1646, *a, b, c*. This can be fitted up as Donovan's Filtering Apparatus, No. 1630.

4-inch, 9s. 6d. | 5-inch, 10s. 6d. | 8-inch, 12s.



17. Separatory Funnel, fine Bohemian glass, angular form, with stoppered neck and glass stopcock, Fig. 1647, 5 inches diameter, 10s. ; 6 inches, 10s. 6d.

For one particular use of this article, see No. 1618.

18. Percolator, slight blown glass, pear-shaped funnel, with stopper, Fig. 1648, total height 8 inches, contents of flask about 5 ounces, 2s.
19. Percolator, small size, with glass stopcock and stopper, form of Fig. 1649, bulb 2 inches diameter, flask contains about 4 ounces, 5s.
20. Percolator, with glass stopcock, form of Fig. 1649, but with a neck on the shoulder like Fig. 1655, funnel 1 pint, flask $1\frac{1}{2}$ pint, German glass, 7s. 6d.
21. Percolator, slight blown glass, with globular funnel, Fig. 1651, contents of flask $\frac{1}{2}$ ounce ; serve also to apply acid in drops or small quantities, 9d.
22. Percolator, with globular funnel, form of Fig. 1651, 6 inches diameter, wide mouth, stoppered flask 4 pints, Bohemian glass, 9s.



1640.



1641.



1642.



1648.



1649.



1651.

1653. Percolator, with globular funnel, Fig. 1651. Contents of flask $1\frac{1}{2}$ pint, funnel 4 inches diameter, with glass stopper, German glass, 5s.
1654. Percolator, with pear-shaped funnel, Fig. 1648 and 1640, but without handle, contents of flask, $1\frac{1}{2}$ pint, German glass, 5s.
1655. Percolator, fine Bohemian glass, with angular funnel, wide mouth, stoppered with neck at shoulder, Fig. 1655. Price, according to the capacity of the receiving bottle:—

2 pints, 7s. 4 pints, 8s. 8 pints, 9s.

In the event of any strong pressure being required to force the liquor through the powder that is placed in the percolator, an exhausting syringe (see No. 727) may be adapted to the side neck of the receiving bottle, and a partial vacuum being produced in the bottle, the atmospheric pressure in the unstopped funnel then acts powerfully.

1656. Percolator, fine Bohemian glass, with ground-edge funnel, covered by a stoppered ground glass plate with neck at shoulder, Fig. 1656. Price, according to the capacity of the receiving bottle:—

2 pints, 12s. 4 pints, 13s. 8 pints, 14s.

1657. Percolator, consisting of a cylindrical bottle and a cylindrical funnel, the latter with a ground glass stopper; general form nearly resembling Fig. 1656, but holes are drilled through the stopper and the neck, to which it is ground, and also through the neck of the funnel and the neck of the bottle, so that by turning round the stopper or the funnel, communication can be made between the contents and the external air. Best white German glass, the fittings well ground, price according to the capacity of the bottle,

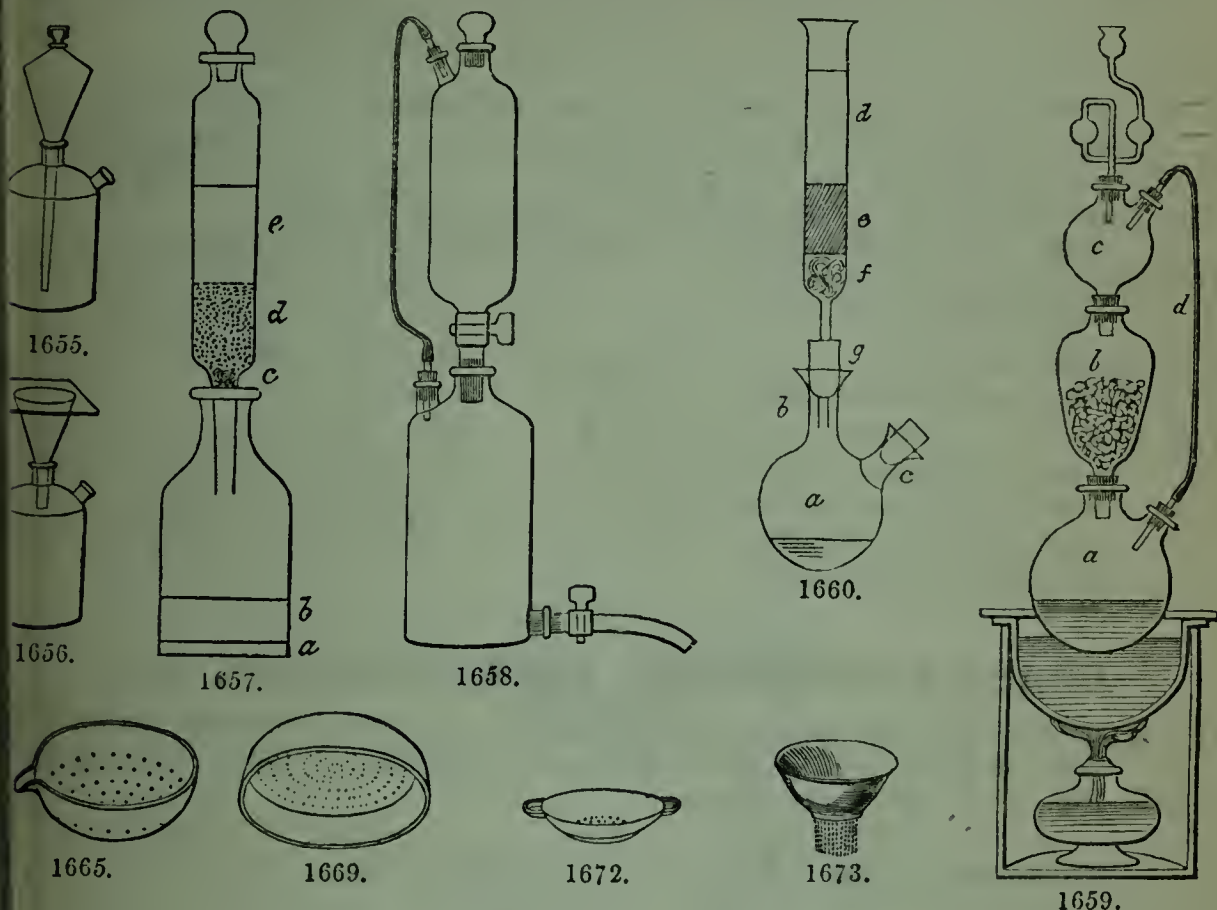
$\frac{1}{2}$ pint, 4s.		$1\frac{1}{2}$ pint, 6s.
1 pint, 5s.		2 pints, 8s.

1658. American Percolator, for preparing extracts by means of ether, alcohol, or other volatile liquids, Fig. 1658, capacity of the receiving bottle, 12 pints; of the cylindrical funnel, 4 pints; fine Bohemian glass, with two glass stopcocks and connectors, 33s.

1659. Payen's Percolator, for preparing extracts by means of hot alcohol or ether, the bulb *a* being placed in a water bath (REGNAULT, *Cours de Chimie*, I. p. 5). Small size, the glass part only, *a*, *b*, *c*, *d*, *e*, without furnace and water bath, the bulb *a* $2\frac{1}{2}$ inches diameter, the percolator *b* 4 inches long, Fig. 1659, the set, 5s. 6d.

1660. Döbereiner's Percolator, or Extracting Apparatus, for experimenting on small quantities, consisting of a 3 ounce Glass Flask with two necks, and a tube 7 inches by $\frac{3}{4}$ inch, connected by a cork, Fig. 1660, 1s.

A vacuum being made in the flask *a* by the evaporation of a few drops of alcohol, and the neck *c* closed by the cork, the liquid *d* is then forced, by atmospheric pressure, through the powder *e*, and the cotton *f*, into the lower vessel, producing an extract of the powder *e*.



DRAINERS, STRAINERS, COLANDERS, SIEVES.

5. Thuringian Porcelain Capsules, with perforated bottoms, for draining or filtering, Fig. 1665; can be conveniently placed over a beaker or lixiviating jar.

The following sizes :—

The 4 largest sizes.

No. 1.	6½-inch,	16 ounces,	1s. 6d.
2.	5¾ "	14 "	1s. 4d.
3.	5½ "	10 "	1s. 2d.
4.	4½ "	6 "	1s.

The 5 smallest sizes.

No. 5.	4 inch,	5 ounces	11d.
6.	3¾ "	4 "	10d.
7.	3¼ "	3 "	9d.
8.	3 "	2 "	8d.
9.	2½ "	1 "	7d.

5a. The set of 4, 5s.

5b. The set of 5, 3s. 6d.

5c. The complete set of 9 strainers, 8s.

6. Thuringian Porcelain Drainers, flat bottom, vertical sides, form of Fig. 1669.

	Diameter.	Depth.		Diameter.	Depth.		
1.	12 inches.	2¼ inches,	5s. 6d.	No. 4.	7½ inches.	2¼ inches.	2s. 6d.
2.	11 „	2½ „	4s. 6d.	5.	6 „	3 „	1s. 9d.
3.	9½ „	2½ „	3s. 6d.				

1670. Thuringian Porcelain Drainer, vertical form, Fig. 1670, useful as an eye-bath, 1 inch high, $\frac{1}{2}$ inch wide, 4d.
 1671. Colander, or Strainer, for separating Crystals from mother liquor, &c., German semi-porcelain, with hard close porcelain glaze, not attacked by acids or colours, form of a basin, Fig. 1671, pierced with holes.

No. 9.	13 inches diameter.	Contents, 9 pints,	7s. 6d.
10.	14 "	11 "	8s. 6d.
11.	16 "	15 "	9s. 6d.

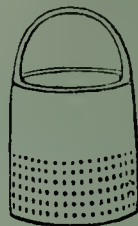
1672. Crystal Drainer, Berlin Porcelain, 5 inches diameter.
 1672. Shallow, with handles, Fig. 1672, page 175, 1s. 2d.
 1673. Deep, without handles, Fig. 1673, 1s. 6d.
 1674. Sieve for Holding Dyewood, &c. in boiling liquors, Thuringian porcelain, with handle at the side, Fig. 1674, 9s.
 1675. Ditto, with bail or bow handle, Fig. 1675.

- 1, Deep form, 9s.
 2, Broad and shallow, 7s.

1676. Decoction Strainer, consisting of 4 pieces, namely, funnel, sieve, pestle and ring, Fig. 1676, Thuringian porcelain, *the set*, 5s.



1674.



1675.



1676.



1671.



1670.

GLASS COVERS FOR JARS, FUNNELS, &c.

1677. GLASS CIRCULAR COVERS, for Basins, Funnels, Jars, &c., consisting of round discs of glass, either plain or ground on one side, to close vessels air-tight Fig. 1677. *Price per dozen*:—

Diameter.	1677. Plain.	1678. Ground.	Diameter.	1677. Plain.	1678. Ground.
2 inch	5d.	9d.	5 inch.	1s.	2s.
2½ "	5d.	9d.	5½ "	1s. 3d.	2s. 3d.
3 "	6d.	10d.	6 "	1s. 6d.	2s. 6d.
3½ "	7d.	1s.	7 "	2s.	3s.
4 "	8d.	1s. 3d.	8 "	2s. 6d.	4s.
4½ "	10d.	1s. 6d.	9 "	3s. 6d.	6s.

1679. Glass Covers, circular, flat, thick glass, with one inch funnel-hole in the centre, Fig. 1679.

4 inch, 1s. | 5 inch, 1s. 2d. | 6 inch, 1s. 4d. *each*.

1681. Glass Covers, circular, flat, with a slit at the side to receive a funnel, Fig. 1681.

4 inch, 1s. | 5 inch, 1s. 2d. | 6 inch, 1s. 4d. *each*.

1682. Concave Covers for Glass Jars, with central neck to support a funnel, Fig. 1682, Bohemian glass,

3 to 4 inch, 6d. | 4½ to 5 inch, 9d. | 6 inch, 1s.

1683. Concave Covers, without funnel neck. See Shallow Evaporating Dishes.

1684. Concave Covers, of stout glass, with depression to prevent their slipping a jar, 6½ inches diameter, Fig. 8, No. 1800, 1s.



1677.



1679.



1681.

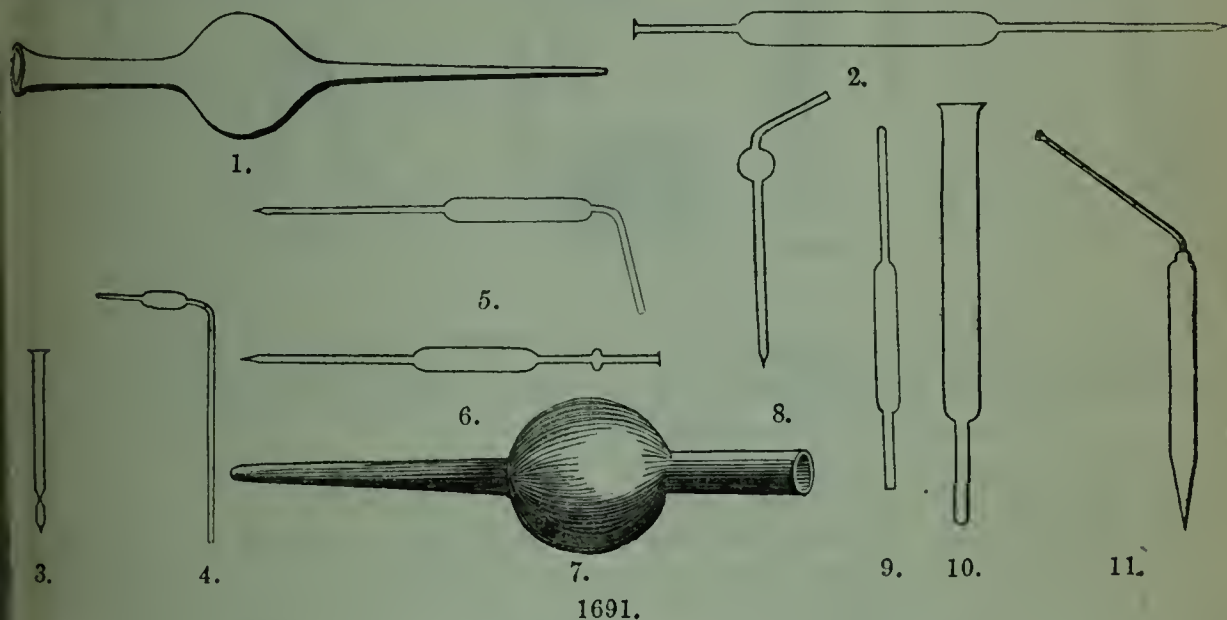


1682.

685. Circular Glass Covers, of thick plate glass, ground and polished on the edges,
3 inch, 1s. | 4 inch, 1s. 6d. | 5 inch, 2s. | 6 inch, 3s.
686. Covers, of dome form, to put over specimens to protect them from dust, &c.,
from 1s. upwards.
- For other Covers of the dome form, see the article on Receivers for Gase s.

PIPETTES, SIPHONS, SYRINGES.

GLASS PIPETTES, for transvasing liquors, applying tests, washing filters, &c., all
made of hard white German glass, not graduated.

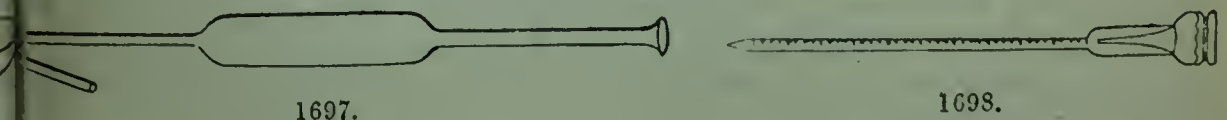


90. STRAIGHT PLAIN GLASS PIPETTES, without enlargement, Fig. 1690.
- | | |
|---|--|
| 1. 4 inches long, $\frac{1}{4}$ inch wide, 1½d. | No. 4. 6 inches long, $\frac{3}{8}$ inch wide, 2d. |
| 2. 5 " $\frac{1}{4}$ " 1½d. | 5. 10 " $\frac{3}{8}$ " 3d. |
| 3. 5 " $\frac{3}{8}$ " 2d. | |
6. 12 inches long, $\frac{1}{3}$ inch wide, of hard Bohemian glass, with fine point,
for burning a jet of hydrogen gas, 4d.
7. 6 inches long, $\frac{1}{3}$ inch wide, with neck, Fig. 1691, No. 3, 3d.

91. GLASS PIPETTES with BULBS, or with CYLINDRICAL RESERVOIRS, with necks
or points either straight or bent.

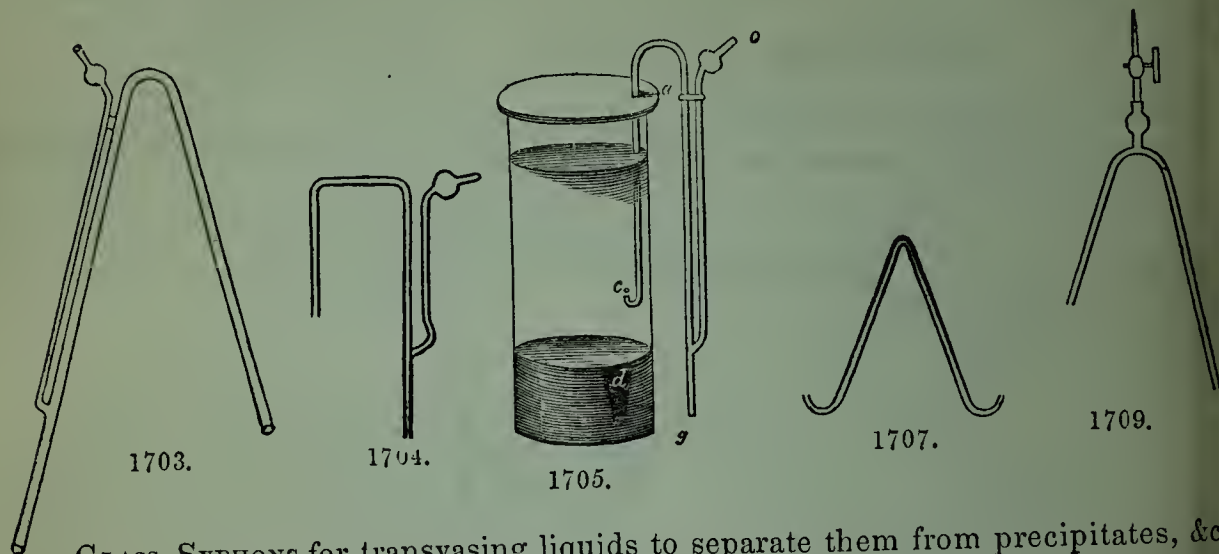
*Purchasers are requested to indicate, by the NUMBER of the FIGURE, from 1
11, group of Figures, 1691, which FORM they wish to receive.*

- | | |
|---|---|
| 92. Contents, $\frac{1}{2}$, 1, or 1½ ounce, 3d. each. | 1694. Contents, 2½ or 3 ounces, 6d. each. |
| 93. Contents, 2 ounces, 4d. each. | 1695. Contents, 3½ or 4 ounces, 8d. each. |



6. Large Pipette, form of Fig. 1691, No. 2, body 12 inches long by 1 inch wide, 1s.
7. Pipette for passing Solution of Potash, or other liquid test, into Gas Tubes,
over mercury, Fig. 1697, 6d.

1698. Graduated Dropping Tube, with caoutchouc cover, Fig. 1698, 2s.
 1699. Pipettes made of thick tube, or those which have pear-shaped reservoirs, are higher in price.
 1700. Pipettes made to measure *exact quantities* of liquor, are described among the Apparatus for Centigrade Testing.



GLASS SYPHONS for transvasing liquids to separate them from precipitates, &c.

1701. Plain Glass Syphon, form of Fig. 1703, but without the suction tube, small size, namely, 13 inches long, 6d.
 1702. Ditto, large size, namely, 15 inches long and stronger than the preceding, 8d.
 1703. Syphon, with suction tube, large size, Fig. 1703, 1s. 6d.
 1704. Mitscherlich's Syphon, form represented by Fig. 1704 and by *a, c*, Fig. 1705, with suction tube.

With Slender Tube.		
No. 1.	10 inch,	8d.
2.	15 "	10d.
3.	21 "	1s.
4.	30 "	1s. 3d.

With Strong Tube.		
No. 5.	12 inch,	9d.
6.	18 "	1s.
7.	24 "	1s. 3d.
8.	36 "	1s. 6d.

This syphon has the two branches pretty wide apart, as represented by Fig. 1704, not so close together as shown in Fig. 1705. The lower end of the short limb is either turned upwards as represented by Fig. 1705, or is closed and pierced with small side holes. The object of this is to avoid stirring up the precipitate which lies at the bottom of the solution that is to be decanted.

1706. Mitscherlich's Syphon, small size, with caoutchouc tube attached to the suction tube, to enable the operator to watch the rise of the liquid conveniently, 1s. 6d.
 1707. Wirtemberg Syphon with equal branches, Fig. 1707, small size, 25 inch, 1s.
 1708. Ditto, large size, wide tube, 36 inch, 1s. 6d.

To set this syphon in action, it is filled with some of the liquor that is to be decanted, or a straight tube for suction may be attached to the outer end of the syphon by means of a cork. The tube is to be removed when the liquor has come over the bend of the syphon.

1709. Syphon for decanting Acids, form of Fig. 1709, with a brass stopcock, 3s. 6d.
 1710. Syphon for Decanting Acids, form of Fig. 1709, but with a glass valve and caoutchouc tube, instead of a metal stopcock, length from end to end about 30 inches, 1s. 6d.

1711. Syphon with suction tube and a glass stopcock.

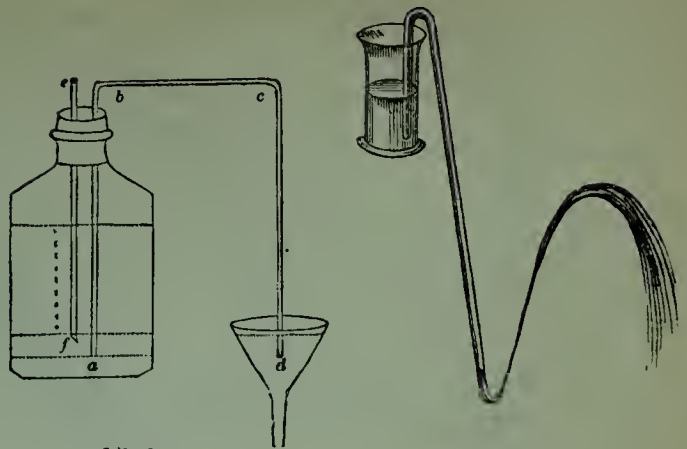
18 inch,	4s.		24 inch,	4s. 6d.
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12. Gay-Lussac Syphon, which, when arranged as shown by Fig. 1712 *a, b, c, d*, supplies a continuous current of water, to wash a precipitate in a funnel, tube about 25 inches long, 1s.

13. Eye Fountain or syphon for spreading a gentle shower of water, Fig. 1713.

18 inch, 9d.		30 in., 1s. 2d.
24 inch, 1s.		36 in., 1s. 4d.

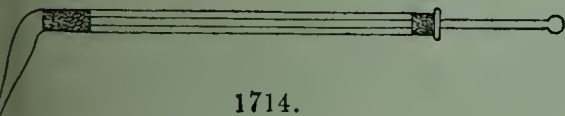
This syphon can be used to distribute liquids gradually, such as acid upon bleaching powder to liberate chlorine continuously in small quantity for disinfection, &c.



1712.

1713.

14. SYRINGES or GLASS PUMPS for washing precipitates or filters, decanting liquids from above precipitates, &c. made of glass, with tow or cotton wool on the piston, form of Fig. 1714, size of wide tube, 10 inches by $\frac{3}{4}$ inch, with bent point, 2s.



1714.



1715.

15. Ditto, with straight point, 2s.

16. Ditto, small size, straight point, for Injections:—

3-inch, 3s. 6d		4-inch, 3s. 9d.		5-inch, 4s. <i>per dozen</i> .
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ELUTRIATION.

17. Decanting Vessels, for the washing of powders and their separation into different degrees of fineness, Fig. 1717, Thuringian porcelain.

4 pints,	7s.		11 pints,	12s. 6d.		16 pints,	18s.
6 „	10s.		13 „	14s.		20 „	22s.



1717.

18. Schulze's Apparatus for the Mechanical Analysis of Soils, Clays, ground Ores, &c. by Elutriation, or washing with water, Fig. 1718, 5s.

The soil or other powder is diffused in water in the glass *a*. Water is run from a water bottle through the funnel *b*. The lower end of the tube *c* is raised more or less from the bottom of the glass, fixed by a cork at *d*. The fine powder flows off with the water by the pipe *e*, into a beaker to receive it. By raising the funnel more or less from the bottom of the glass *a*, the stirring force of the fall of water is modified at discretion.

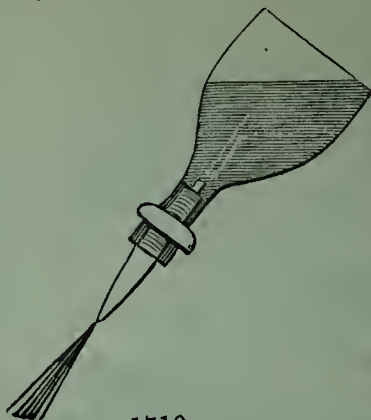
The conical glass is 9 inches high and 3 inches diameter at the mouth.



1718.



1721.



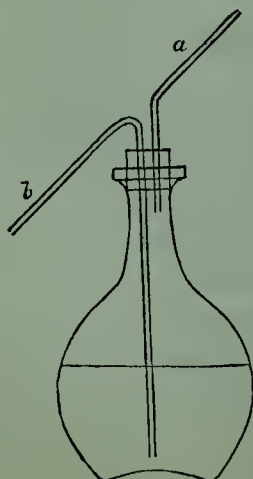
1719.



1720.

WASHING BOTTLES.

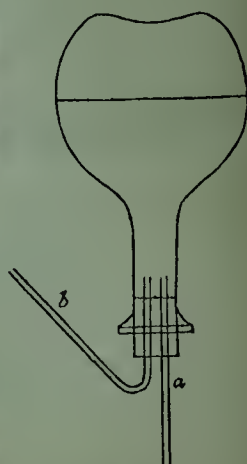
1719. Berzelius's Washing Bottle with single jet, for the washing of precipitates on filters, by a fine but strong jet of water produced by air compressed in the bottle by the mouth, Figs. 1719 and 1720. The jet is represented by Fig. 1721. One pint flask, fitted, 1s.
1720. Ditto, quart size, 1s. 6d.
1721. The jet alone, 2d.
1722. Berzelius's Washing Bottle fitted with handle, for use with boiling water. Fig. 1722 *a*, *b*, pint size, 2s.
1723. Washing Bottle, with jet and blowing tube, Fig. 1723, white glass flask, size one pint or less, 1s. 3d.
1724. Ditto, cylindrical green glass bottle, one pint size, 1s.
1725. Ditto, white glass bottle, with caoutchouc blowing tube, Fig. 1725, 1s. 6d.
1726. Washing Bottle, with jet and blowing pipe, fitted with handle, form of Fig. 1722 *b*, for use with boiling water, one pint, 2s. 6d.

1722 *a*.1722 *b*.

1723.



1725.



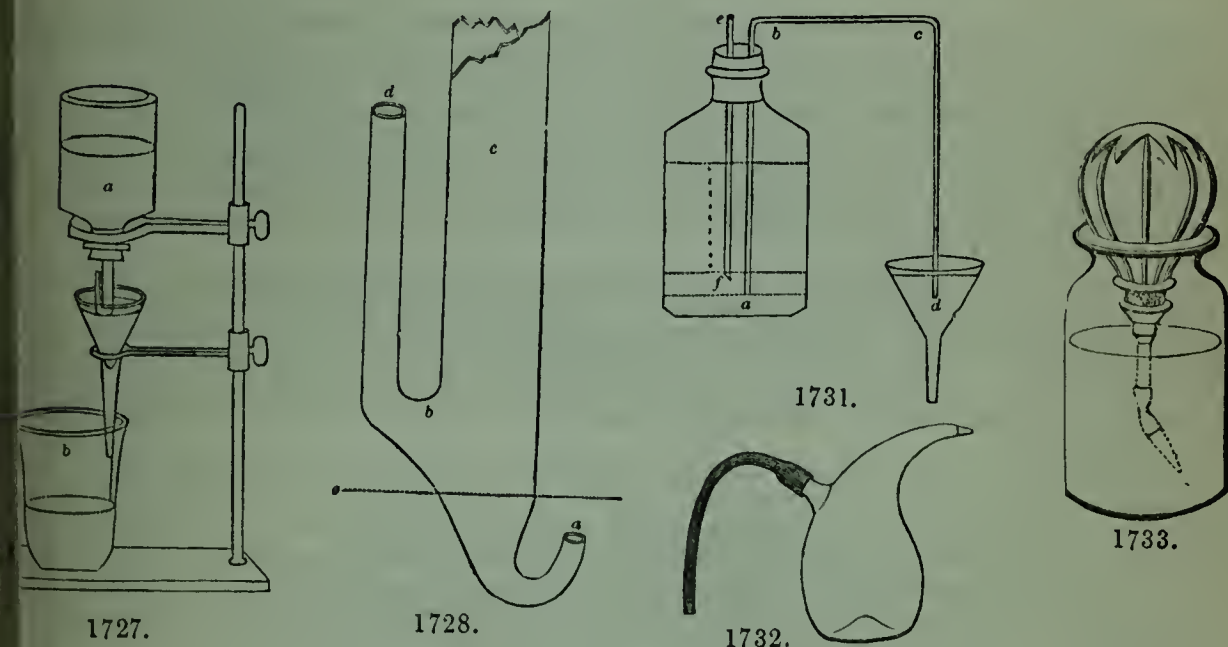
1729.

1727. Berzelius's Fountain Bottle, for supplying a continuous current of pure water or other liquid to wash a precipitate upon a filter, represented in action by Fig. 1727, the washing tube being represented by Fig. 1728, $1\frac{1}{2}$ pint bottle, fitted with the tube, 1s. 6d.
1728. The Washing Tube alone, Fig. 1728, 4d.
1729. Gmelin's Modification of the Fountain Washing Bottle, represented by Fig. 1729, $1\frac{1}{2}$ pint size, 1s. 3d.
1730. The same, mounted with handle, like Fig. 1722 *b*, for use with hot water, 2s. 6d.
1731. Gay Lussac's Syphon Washing Bottle, which yields a continuous current of water to wash a precipitate, Fig. 1731, the syphon tube 25 inches long, the bottle four pint size, fitted, 3s. 6d.
1732. Washing Bottle, with a fine orifice for the jet of water, and a blowing tube with caoutchouc mouthpiece attached; useful in washing small precipitates, and in experiments of metallic reductions with the blowpipe, contents 2 ounces. Fig. 1732, 1s.

Washing by Pipettes. Any of the pipettes described in Nos. 1690 to 1700 may also be used for washing precipitates.

1733. Caoutchouc Washing Bottle, with glass jet, Fig. 1733.

1 ounce, 1s. | 2 ounces, 1s. 3d. | 4 ounces, 1s. 8d. | 6 ounces, 2s.



1734. Hot Water Jugs, of saltglazed stoneware, with handle and spout, capable of being heated on a sand bath, or, with care, over a rose gas-burner.

1 Pint, 1s. | 2 Pints, 1s. 6d. | 3 Pints, 2s. 6d.

1735. Hot Water Jugs, of saltglazed stoneware, form of Fig. 1734, but fitted with washing jet and blowing tube, like Fig. 1725.

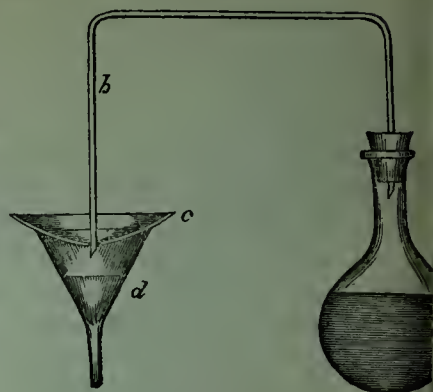
1 Pint, 1s. 6d. | 2 Pints, 2s. | 3 Pints, 3s.



1734.

1736. Shier's Apparatus for Washing Precipitates by Steam, consisting of a flask, syphon tube, and a perforated glass capsule, Fig. 1736, 3s. 6d.

a is a water bottle; *b*, a narrow glass tube of $\frac{1}{2}$ inch bore; *c*, a very shallow glass capsule, perforated in the centre; *d*, a glass funnel. *Use*.—The precipitate is supposed to be on a paper filter in the funnel. Water is boiled in the bottle *a*, and the steam passed into the funnel, where it condenses into boiling hot distilled water, which rapidly washes the precipitate. The pressure of the steam and the high temperature greatly facilitate the process. If the steam comes off too fast, it blows out between the capsule and the funnel, and does no harm. But it is easy, when the water is boiled by a gas flame, or over a lamp, to provide against waste of steam. Care must be taken that the water in the funnel does not rise so high as to touch the slant-cut end of the steam-pipe. The use of this apparatus effects a great saving of time in one of the most tedious operations of Analytical Chemistry.



1736.

Dialysis.

The process of Chemical Analysis by means of Liquid Diffusion, recently discovered by Thomas Graham, Esq., F.R.S., Master of the Mint, is described in his Memoir on "Liquid Diffusion applied to Analysis," printed in the "Transactions of the Royal Society," for 1861, page 183.

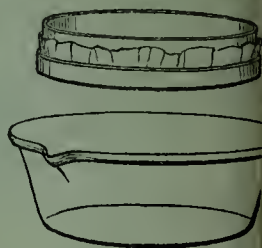
The Dialyser, or apparatus for effecting Analysis by Diffusion, invented by Mr. Graham, consists of a species of sieve, having gutta percha sides and a parchment paper bottom. A mixed liquid to be analysed is put into the Dialyser, and the Dialyser is floated in distilled water contained in a flat basin. At the end of twenty-four hours, the crystallisable substances contained in the mixed liquid will have diffused into the distilled water of the basin, leaving the gelatinous substances of the mixture still in the Dialyser.

By means of this Dialysing Apparatus, arsenious acid, metallic salts, strychnine, and other poisonous mineral and organic, can be readily separated from organic solutions in medico-legal inquiries. The process has the advantage of introducing no metallic substance or chemical re-agent of any kind into the organic fluids. The arrangement for operating is also of the simplest nature. Very minute quantities of arsenic have been separated by the dialytic process from egg albumen, gum arabic, isinglass, milk, porter, blood, and animal intestines, and obtained in a solution fit for the application of re-agents.

The Dialyser serves also for the separation and decomposition of many metallic salts; for the separation of urea and other crystallisable salts from urine; for the separation in general of all *crystalloids* or crystallisable bodies from all *colloids* or gelatinous bodies; and for the preparation and purification of such colloids as hydrated silicic acid, hydrated alumina, gelatine, albumen, starch, caramel, tannin, gummic acid, &c. In short, the Dialyser is an instrument of great practical utility to all Chemists, Physiologists, &c., who are engaged in researches into the composition of organic mixed liquids.

Instructions for operating with the Dialyser.—The Dialyser consists of two gutta percha hoops, one of them two inches deep, and the other, one inch deep. The two-inch hoop is slightly conical, and the one-inch hoop goes over the small end of the two-inch hoop. Both must be washed very clean with distilled water. The parchment paper that is to form the bottom must be about three inches wider than the small end of the two-inch hoop.

Soak the parchment paper for about a minute in distilled water; stretch it evenly over the small end of the two-inch hoop, and strain it tight by pushing over it the one-inch hoop. The paper must be pressed smoothly up round the outside of the larger hoop, and the bottom must be quite flat and even. There must be no small holes in the paper. To try this, put distilled water into the Dialyser, to the depth of a quarter-inch, and place the Dialyser on some white blotting-paper. If any wet or dark spots appear, they indicate the existence of



1737.

small holes. To close such holes, apply to the under surface of the paper about the holes some liquid albumen, put on a small patch of parchment paper, and iron the patch with a hot smooth iron. This coagulates the albumen, fixes the patch, and closes the hole.

The Dialyser being prepared, the liquid to be operated upon is to be put into it, to the depth of not more than half an inch, and the Dialyser is then to be floated on distilled water contained in a flat basin. The quantity of the water in the basin should be about five times as much as that put into the Dialyser. The whole is then to be set aside for twenty-four hours.

A Dialyser of 6 inches diameter serves to operate upon 7 or 8 fluid ounces of liquid; one of 8 inches diameter for 12 or 14 fluid ounces; one of 10 inches diameter for 20 fluid ounces; and one of 12 inches diameter for 30 fluid ounces. The wider the Dialyser and the greater the quantity of distilled water used in the outer basin, the more rapid and effective is the diffusion.

DIALYTIC APPARATUS.

1737. Gutta Percha Dialyser, in two pieces, as described above:—

6 inches in diameter, 3s. 6d.	10 inches in diameter, 5s. 6d.
8 " " 4s. 9d.	12 " " 6s. 6d.

1737 a. Parchment Paper, of the best quality, selected specially for this process, and in pieces to suit the sizes of the Dialyser, price per dozen:—

8½ in. square, for 6 in. Dialyser, 1s.	12½ in. square, for 10 in. Dialyser 2s.
10½ " 8 " 1s. 6d.	14½ " 12 " 2s. 6d.

1737 b. Flat Conical Glass Basins with Spout, to hold distilled water below the Dialyser, and collect the diffusate.

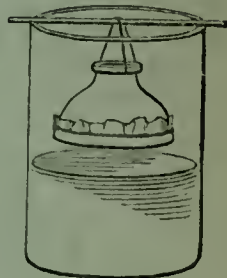
9 in. basin, to suit 6 in. Dialyser 2s.	13 in. basin, to suit 10 in. Dialyser 3s. 6d.
1 " 8 " 2s. 6d.	15 " 12 " 5s.

1738. BELL-SHAPED DIALYSERS, of Glass, Fig. 1738, with two flanges.

3 inch bore, 8d.	Corresponding papers, per dozen, 9d.
4 " 10d.	" " 9d.
5 " 1s.	" " 1s.

Cylindrical Jars suitable for these Dialysers are described at No. 1530.

In using these Dialysers, the parchment paper is strained over the wide end, and tied with a thread above the flange. The vessel is then suspended in a wide jar, containing the water into which the crystallisable substance is to be diffused. It can be suspended from a glass rod by a string tied round the neck of the Dialyser. The water in the jar must cover the face of the parchment paper, but not rise above the outer edge.



1738.

GLASS SHADES.

1739. GLASS SHADES, round, oval, and square. LIST OF PRICES:—

Inches.	Price.			Inches.	Price.			Inches.	Price.		
	Round.	Oval.	Square.		Round.	Oval.	Square.		Round.	Oval.	Square.
	s. d.	s. d.	s. d.		s. d.	s. d.	s. d.		s. d.	s. d.	s. d.
10	6	1	1 6	30	2	3 8	4 2	50	6 3	7 8	11
12	7	1 2	1 9	32	2 1	3 11	4 5	55	8 4	11 4	16
14	8	1 4	2 3	34	2 3	4 1	4 8	60	12 6	16	22
16	10	1 8	2 7	36	2 5	4 4	4 11	65	18	23	32
18	1	2	2 10	38	2 8	4 7	5 3	70	26	33	43
20	1 2	2 4	3 1	40	3	4 11	5 7	75	36	45	58
22	1 4	2 8	3 4	42	3 4	5 3	6	80	46	55 6	74
24	1 6	3	3 7	44	3 10	5 7	7	85	60	78 6	94
26	1 7	3 2	3 10	46	4 6	5 11	8 3	90	86	106	118
28	1 10	3 5	4	48	5 3	6 6	9 3	95	116	136	148

The total number of inches in a shade is calculated as follows:—

Round Shades—Once the height, added to three times the diameter.

Oval Shades—Once the height, twice the length, once the breadth.

Square Shades—Once the height, twice the length, once the breadth.

The height is never charged less than the length or diameter.

*Examples:—*A Round Shade, 12 inches in height and 6 inches in diameter, is reckoned 30 inches, price 2s.; an Oval shade, 12 inches in height, 8 in length, and 6 in width, is reckoned 34 inches, price 4s. 1d.

Shades of any required size can be supplied. The quotations in the above List are merely to show the range of prices.

1739a. POLISHED BLACK WOODEN FEET for Round Shades, *price according to diameter*

1. Under 7 inches, at 2d. per inch;

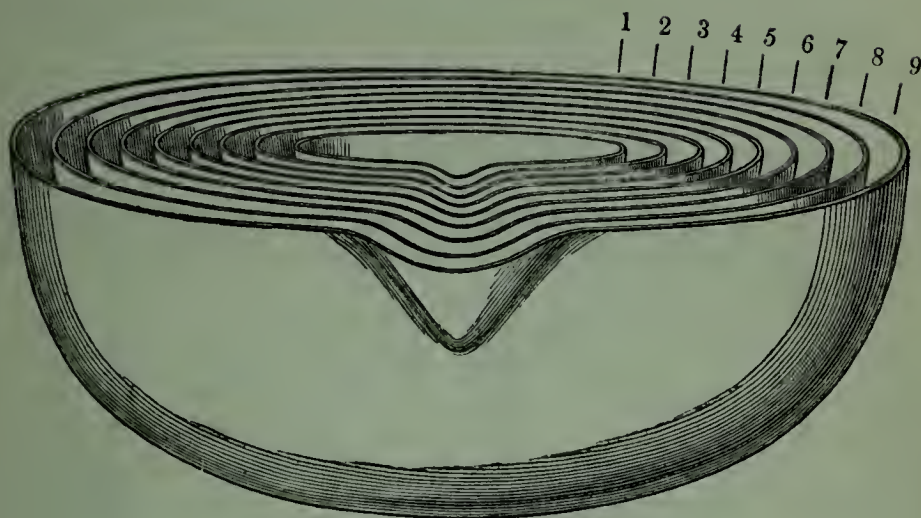
2. From 7 inches to $9\frac{1}{2}$ inches, at $2\frac{1}{2}$ d. per inch;

3. Above $9\frac{1}{2}$ inches, at 3d. per inch.

Polished Black Wooden Feet, for Oval and Square Shades, according to length 4d. per inch.

CHENILLE to put round the edges of shades to keep out dust, per yard, 2d.

Evaporation.



1740.

PLATINUM EVAPORATING BASINS.

1740. PLATINUM EVAPORATING BASINS with Spout, form of Fig. 1740.

The following particulars are subject to considerable variation, and they are given only to afford a general idea of the probable cost of a basin of a given size. The exact cost may be less or more than the sum here stated. It depends on the market price of the metal, and on the thickness of the vessel. When a basin of a particular strength is required, it is requested that the desired thickness, as shown by the metal plate gauge in page 4, may be stated.

No.	Diameter.	Contents.	Weight.	Price.	No.	Diameter.	Contents.	Weight.	Price.
1.	1 $\frac{3}{8}$ in.	$\frac{1}{4}$ oz.	170 grs.	14s.	6.	2 $\frac{3}{4}$ in.	1 $\frac{1}{2}$ oz.	500 grs.	40s.
2.	1 $\frac{3}{4}$ "	$\frac{1}{2}$ "	220 "	18s.	7.	3 "	2 $\frac{1}{4}$ "	550 "	45s.
3.	2 "	$\frac{3}{4}$ "	270 "	22s.	8.	3 $\frac{1}{4}$ "	3 $\frac{1}{4}$ "	730 "	60s.
4.	2 $\frac{1}{4}$ "	1 "	340 "	28s.	9.	3 $\frac{1}{2}$ "	4 "	900 "	75s.
5.	2 $\frac{1}{2}$ "	1 $\frac{1}{4}$ "	400 "	33s.					



1741. Platinum Evaporating Basins and Cups, small sizes and shallow form, Figs. 1741 a, b, c, d, serving also as covers to crucibles, and in lieu of blowpipe spoons.

The small Platinum Cups supported by a pair of slight Steel Tongs, either with or without Platinum points, will be found to answer the purpose of Platinum Spoons, while they are cheaper and more convenient. They are beaten very thin to facilitate the production of a high temperature

to act on the substances ignited in them. After a fusion, the cup can be separated from the tongs, and boiled, with its contents, in a proper solvent in a small flask, by which means a solution of the assay is procured, and the vessel cleaned at the same time.

No.	Diameter.	Depth.	Price.	No.	Diameter.	Depth.	Price.
1.	$\frac{1}{4}$ inch.	$\frac{1}{8}$ inch.	9d.	5.	1 "	$\frac{1}{4}$ "	5s. to 6s.
2.	$\frac{3}{8}$ "	$\frac{1}{6}$ "	1s.	6.	$1\frac{1}{2}$ "	$\frac{1}{4}$ "	10s.
3.	$\frac{1}{2}$ "	$\frac{1}{4}$ "	2s.	7.	2 "	$\frac{1}{2}$ "	18s.
4.	$\frac{3}{4}$ "	$\frac{1}{6}$ "	3s. to 4s.				

1742. Steel Tongs for holding these Capsules before the blowpipe, or in a gas flame, No. 130, 6d.

PORCELAIN EVAPORATING BASINS.

1743. BERLIN PORCELAIN EVAPORATING BASINS, OR CAPSULES, with spout, Fig. 1743 glazed inside and outside, but not on the edge. *Depth of the Capsules, = one third of their diameter.*

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	$2\frac{3}{4}$ inches.	2 ounces.	4d.	6.	6 inches.	16 ounces.	1s. 7d.
0.	$3\frac{1}{4}$ inches.	$2\frac{1}{2}$ ounces.	5d.	7.	$7\frac{1}{4}$ inches.	1 pint.	2s.
1.	$3\frac{1}{2}$ inches.	3 ounces.	7d.	8.	$8\frac{1}{2}$ inches.	2 pints.	2s. 8d.
2.	$3\frac{3}{4}$ inches.	4 ounces.	7d.	9.	10 inches.	4 pints.	4s.
3.	4 inches.	6 ounces.	10d.	10.	12 inches.	7 pints.	6s. 6d.
4.	$4\frac{1}{2}$ inches.	8 ounces.	1s.	11.	14 inches.	10 pints.	7s. 6d.
5.	$4\frac{3}{4}$ inches.	10 ounces.	1s. 3d.	12.	$15\frac{1}{2}$ inches.	18 pints.	24s.

1744. Price of the 14 Basins, No. 00 to 12, 52s. 6d.

1745. Price of a Nest of 13 Basins, No. 00 to 11, 29s.

1746. Price of a Nest of 11 Basins, No. 00 to 9, 15s.

1747. Price of a Selection of 6 Basins, containing Nos. 00, 1, 2, 4, 6, 9, 8s.

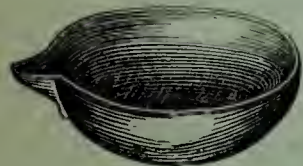
1748. Price of a Selection of 6 Basins, containing Nos. 00, 0, 1, 2, 3, 6, 4s. 4d.

1749. Berlin Porcelain Evaporating Basins, or Capsules, white, glazed, nearly flat bottomed, with spout, Fig. 1749.

Depth about one-fourth of their Diameter.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	$2\frac{3}{4}$ inches.	$1\frac{1}{2}$ oz.	5d.	5.	$4\frac{1}{2}$ inches.	8 oz.	1s.
2.	3 inches.	2 oz.	7d.	6.	5 inches.	12 oz.	1s. 3d.
3.	$3\frac{1}{2}$ inches.	$3\frac{1}{2}$ oz.	8d.	7.	6 inches.	18 oz.	1s. 8d.
4.	4 inches.	5 oz.	10d.				

1750. Nest containing the 7 Capsules, Nos. 1 to 7, 6s. 5d.



1743.



1749.



1751.



1752.

1751. Berlin Porcelain Hemispherical Evaporating Basins, form of Fig. 1751, sold in sets of 4 or 5 times with spout, glazed.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	$5\frac{1}{2}$ inches.	17 ounces.	2s.	4.	$8\frac{1}{2}$ inches.	4 pints.	4s.
2.	$6\frac{1}{2}$ inches.	$1\frac{1}{2}$ pint.	2s. 6d.	5.	$9\frac{1}{2}$ inches.	5 pints.	4s.
3.	$7\frac{1}{2}$ inches.	$2\frac{1}{2}$ pints.	3s. 6d.				

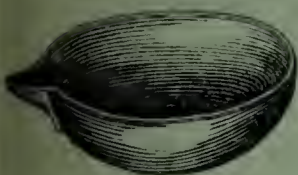
1752. Berlin Porcelain Evaporating Basins, white glazed, nearly hemispherical, thin and uniform in the substance, without rim or lip, Fig. 1752, adapted for weighing in analytical experiments:—

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	1 inch.	$\frac{1}{8}$ ounce.	2d.	3.	2 inch.	1 ounce.	6d.
1.	$1\frac{1}{2}$ inch.	$\frac{1}{2}$ ounce.	4d.	4.	$2\frac{1}{4}$ inch.	$1\frac{1}{2}$ ounce.	8d.
2.	$1\frac{3}{4}$ inch.	$\frac{3}{4}$ ounce.	5d.	5.	$2\frac{1}{2}$ inch.	2 ounces.	10d.

1753. The Set of 6 Basins, 1 inch to $2\frac{1}{2}$ inch, 3s.

1754. DRESDEN (MEISSEN) PORCELAIN EVAPORATING BASINS, form of Fig. 1754, with spout, very thin in body, glazed inside and outside, except a small place on the bottom, outside.

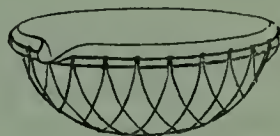
No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	$15\frac{1}{2}$ inches.	16 pints.	18s.	5.	$7\frac{1}{2}$ inches.	$1\frac{1}{2}$ pint.	2s. 6d.
00.	$14\frac{1}{2}$ „	12 „	16s.	6.	$6\frac{1}{2}$ „	1 „	2s.
0.	$13\frac{1}{2}$ „	9 „	12s.	7.	$5\frac{1}{2}$ „	10 ounces.	1s. 6d.
1.	12 „	7 „	7s.	8.	5 „	7 „	1s.
2.	11 „	5 „	5s.	9.	$4\frac{1}{4}$ „	5 „	8d.
3.	10 „	3 „	4s. 6d.	10.	$3\frac{1}{4}$ „	2 „	6d.
4.	$8\frac{1}{2}$ „	2 „	4s.	11.	$2\frac{5}{8}$ „	1 „	5d.



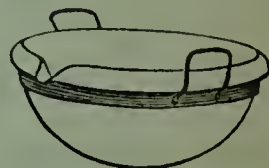
1754.



1755.



1758.



1757.

1755. THURINGIAN PORCELAIN EVAPORATING BASINS, Fig. 1755, thin in body, very good spouts for pouring, glazed inside, biscuit outside.

a. The Set of Nine Basins, as described below, 6s.

b. The Set of Four largest Basins, 3s. 6d.

c. The Set of Five smallest Basins, 2s. 9d.

Separately, as follows:—

b. The 4 largest Basins.

No. 1.	$6\frac{1}{2}$ -inch,	16 oz.,	1s.
2.	$5\frac{3}{4}$ „	14 „	11d.
3.	$5\frac{1}{4}$ „	10 „	10d.
4.	$4\frac{1}{2}$ „	6 „	9d.

c. The 5 smallest Basins.

No. 5.	4-inch,	5 oz.,	8d.
6.	$3\frac{3}{4}$ „	4 „	8d.
7.	$3\frac{1}{4}$ „	3 „	7d.
8.	$2\frac{3}{4}$ „	2 „	6d.
9.	$2\frac{1}{2}$ „	1 „	4d.

1756. Thuringian Porcelain Evaporating Basins, large size, with good spouts, glazed within, biscuit without, with ridge to suit the metal fittings of a water-bath, as shown by Figs. 1757 and 1758.

No. 00.	15 inch,	16 pints,	12s.	No. 3.	10 inch,	4 pints,	3s. 3d.
0.	14 „	12 „	8s. 6d.	4.	9 „	3 „	2s. 9d.
1.	12 „	7 „	5s. 6d.	5.	8 „	2 „	2s. 3d.
2.	11 „	6 „	4s. 6d.	6.	$7\frac{1}{2}$ „	$1\frac{1}{2}$ „	1s. 9d.

1757. Thuringian Porcelain Evaporating Basins, like No. 1756, but with iron handles, Fig. 1757.

No. 00.	15 inch,	16s.	No. 0.	14 inch,	13s.
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1758. Thuringian Porcelain Evaporating Basins, like No. 1756, but covered with a netting of iron wire, to receive a luting, Fig. 1758.

No. 00.	15 inch,	13s.	No. 0.	14 inch,	10s.
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1759. Thuringian Porcelain Evaporating Basin, flat, thin and light, glazed on both sides; diameter, $2\frac{1}{4}$ inches; contents, 1 ounce; Fig. 1759, 4d.
1760. Thuringian Porcelain Evaporating Basins, hemispherical form, without spout, glazed inside, biscuit outside, Fig. 1760.

No. 1.	$4\frac{1}{2}$ inch.	10 oz.	1s.	No. 5.	$2\frac{1}{2}$ inch.	2 oz.	6d.
2.	4 „	8 „	10d.	6.	2 „	1 „	5d.
3.	$3\frac{1}{2}$ „	6 „	9d.	7.	$1\frac{1}{2}$ „	$\frac{1}{2}$ „	3d.
4.	3 „	4 „	8d.	<i>The set of Seven Basins, 4s. 5d.</i>			

1761. Thuringian Porcelain Evaporating Basins, very thin and shallow, with shallow spouts, glazed within and without, Fig. 1761. *The set of Four Basins, 2s. 6d.*

No. 1.	$3\frac{1}{4}$ inch.	2 oz.	10d.	No. 3.	$2\frac{3}{4}$ inch.	1 oz.	6d.
2.	3 „	$1\frac{1}{2}$ „	8d.	4.	$2\frac{1}{2}$ „	$\frac{1}{2}$ „	6d.



1759.



1760.



1761.



1762.



1763.

1762. Thuringian Porcelain Evaporating Basins, cylindrical form, flat bottom, steep sides, with spouts, glazed within, biscuit without, Fig. 1762.

No. 1.	4 inch.	4 oz.	10d.	No. 3.	3 inch.	$2\frac{1}{2}$ oz.	8d.
2.	$3\frac{1}{4}$ „	$3\frac{1}{2}$ „	10d.	4.	$2\frac{1}{2}$ „	2 „	8d.

The Set of Four Basins, 3s.

1763. Thuringian Porcelain Evaporating Basins, flat bottomed and shallow, with vertical sides and spouts, glazed inside, biscuit outside, Fig. 1763.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	$16\frac{1}{2}$ inch.	13 pints.	12s.	1.	11 inch.	4 pints.	4s. 6d.
00.	$13\frac{1}{2}$ „	10 „	10s.	2.	10 „	2 „	3s. 6d.
0.	12 „	$6\frac{1}{2}$ „	6s. 6d.	3.	$6\frac{1}{2}$ „	1 pint.	1s. 9d.

1764. Thuringian Porcelain Shallow Evaporating Basins, or Pans, flat bottoms, with nearly vertical sides, with spout, glazed inside and outside, Fig. 1764.

No.	Diameter.	Depth.	Contents.	Price Without Handles.	Price with Two Handles.
1.	$11\frac{1}{2}$ inches.	4 inches.	6 pints.	4s. 6d.	5s. 6d.
2.	11 „	$3\frac{1}{2}$ „	5 „	3s. 6d.	4s. 6d.
3.	$9\frac{1}{2}$ „	$3\frac{1}{4}$ „	4 „	2s. 6d.	3s. 6d.
4.	$8\frac{1}{2}$ „	3 „	3 „	1s. 9d.	2s. 9d.

1765. Thuringian Porcelain Crystallising Pan, consisting of an evaporating basin with a closely-fitting cover; diameter, 18 inches; contents, 14 pints, 15s.

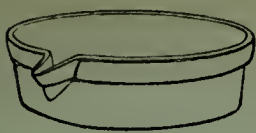
BERLIN SEMI-PORCELAIN EVAPORATING BASINS

1766. BERLIN SEMI-PORCELAIN EVAPORATING BASINS, very stout, with hard porcelain glaze, form of Fig. 1766, shallow, with spout.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	$3\frac{1}{2}$ inch.	2 ounces.	5d.	6.	$11\frac{1}{4}$ inch.	$4\frac{1}{2}$ pints.	2s. 9d.
0.	$4\frac{1}{4}$ „	4 „	5d.	7.	12 „	5 „	3s. 6d.
1.	$5\frac{1}{4}$ „	8 „	6d.	8.	$12\frac{1}{2}$ „	7 „	4s. 6d.
2.	$6\frac{1}{2}$ „	16 „	8d.	9.	$13\frac{1}{4}$ „	9 „	5s. 3d.
3.	8 „	$1\frac{1}{2}$ pints.	1s.	10.	$14\frac{1}{4}$ „	11 „	6s.
4.	9 „	$2\frac{1}{2}$ „	1s. 4d.	11.	16 „	14 „	7s. 6d.
5.	$10\frac{1}{2}$ „	$3\frac{1}{2}$ „	2s.	12.	18 „	18 „	12s. 6d.



1766.



1764.



1767.



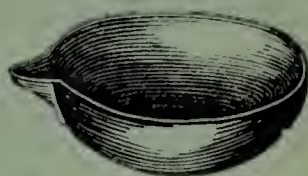
1770.

1767. Berlin semi-porcelain Evaporating Basins, with hard porcelain glaze, deep form, hemispherical, Fig. 1767, with an extra rim for fitting a hole over a water-bath.

Diameter.	Contents.	Price.
6 inches.	1 pint.	1s.
7 „	2 pints.	1s. 6d.
8 „	3 „	2s.
9 „	4 „	2s. 9d.
10 „	5 „	3s. 9d.

Diameter.	Contents.	Price.
11 inches.	6½ pints.	5s. 6d.
12 „	8½ „	6s. 6d.
13 „	10 „	7s. 6d.
14 „	14 „	9s.

1768. Berlin semi-porcelain Evaporating Basins, deep, with spout, with hard porcelain glaze, Fig. 1768. A set of six basins, 2¼, 2¾, 3¼, 3¾, 4¼, 4½ in. diameter, per set, 1s. 8d.



1768.



1769.

1769. Berlin semi-porcelain Evaporating Basins, shallow, without spout, watch glass form, Fig. 1769, with hard porcelain glaze, per set of 6 basins, 2 to 4 inches diameter, 1s. 8d.

Saltglazed Stoneware Evaporating Basins.

1770. BROWN SALTGLAZED STONEWARE EVAPORATING AND CRYSTALLISING BASINS, made very thin at the bottom, and with spreading rim, without spout, Fig. 1770. Can be heated securely over hot sand, over a charcoal fire, or, with precaution, over a spirit-lamp or a rose gas-burner; useful for crystallizing, in consequence of the slight roughness of the surface; also for the evaporation of quantities of saline solutions, which can be carried to dryness if the evaporation is slow. They do not stand a red heat, and are too rough for analytical operations. They are not acted upon by diluted acids.

Depth, one-third of width.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	2½ inches.	1½ ounce.	3d.	7.	5½ inches.	12 ounces.	5½d.
2.	3 „	2½ ounces.	3d.	8.	6 „	16 „	6d.
3.	3½ „	3½ „	3½d.	9.	7 „	20 „	7d.
4.	4 „	4½ „	4d.	10.	8 „	32 „	8d.
5.	4½ „	6 „	4½d.	11.	9 „	40 „	9d.
6.	5 „	8 „	5d.	12.	10 „	60 „	10d.

771. The Set of Twelve Basins, 5s. 6d.

Enamelled Iron Evaporating Basins.

772. Thin Cast Iron Evaporating Basins, lined with glazed earthenware, with spout, Fig. 1772.

6 inch. 1s.	12 inch. 3s.	22 inch. 24s.
8 „ 1s. 6d.	15 „ 6s.	26 „ 32s.
10 „ 2s.	18 „ 9s.	29 „ 35s.

1773. Thin Cast-Iron Hemispherical Basins, lined with glazed earthenware, with two handles, Fig. 1773.

6 inch. 10d. | 8 inch. 1s. | 9 inch. 1s. 6d.
10 inch. 2s. | 13 inch. 3s. 6d.



1772.



1773.

Other sizes of this basin can be supplied up to 33 inches diameter.

Thin Cast-Iron Hemispherical Basins, of the form of Fig. 1773, without enamel of any size from 6 to 15 inches diameter. See No. 1228.

GLASS EVAPORATING BASINS.

1774. BOHEMIAN GLASS EVAPORATING BASINS, hemispherical form, with spout, cut edges, the substance uniformly thick throughout, best hard white glass, without punty mark on the bottom, Fig. 1774.



1774.

No. 1.	2½ inch.	2 ounces.	5d.	No. 7.	6 inch.	1¼ pint.	1s.
2.	3 "	3 "	6d.	8.	7 "	1½ "	1s 3d.
3.	3½ "	5 "	6d.	9.	8 "	2 pints.	1s. 6d.
4.	4 "	8 "	7d.	10.	9 "	3½ "	2s.
5.	4½ "	11 "	8d.	11.	10 "	4 "	2s. 6d.
6.	5 "	16 "	9d.				

1775. The Complete Set of Eleven Glass Evaporating Basins, No. 1 to 11, 10s.

1776. Set of Three Basins, from No. 1 to No. 3, 1s. 3d.

1777. Set of Three Basins, from No. 4 to No. 6, 1s. 9d.

1778. Set of Six Basins, from No. 1 to No. 6, 3s.

1779. Bohemian Glass Evaporating Basins, without spout, but with expanding edge, to adapt them to openings in water-baths, &c., best hard white glass, Fig. 1779, four sizes, 3, 4, 5, and 6 inches diameter; *price per set*, 2s.



1779.



1780.

1780. Bohemian Glass Basins, for Evaporation and Crystallization, serving also pans, trays, troughs, &c., fine white hard glass, flat bottoms, vertical sides, cut edges, uniformly thick, without spouts, Fig. 1780.

No.	Wide.	Deep.	Contents.	Price.	No.	Wide.	Deep.	Contents.	Price.
1.	2 inch.	1¾ inch.	2½ oz.	3d.	8.	5½ inch.	3 inch.	1¾ pints.	10s.
2.	2½ "	2 "	4½ "	3d.	9.	6 "	3¼ "	2¼ "	1s.
3.	3 "	2 "	8 "	4d.	10.	8 "	5 "	6 "	2s.
4.	3½ "	2¼ "	10 "	5d.	11.	9 "	5½ "	8 "	2s. 6d.
5.	4 "	2½ "	14 "	6d.	12.	10 "	6 "	10 "	3s. 6d.
6.	4½ "	2⅝ "	1 pint.	7d.	13.	15 "	7 "	28 "	12s. 6d.
7.	5 "	2¾ "	1¼ "	8d.	14.	18 "	10½ "	66 "	25s.

1781. Price of the Set of Six Basins, from No. 1 to No. 6, 2s.

1782. Price of the Set of Nine Basins, from No. 1 to No. 9, 4s.

1783. Price of the Set of Three Basins, from No. 10 to No. 12, 8s.

1784. Shallow Glass Evaporating Basins (watch-glass form), hard pale green glass, *per dozen* :—

3 inch. 4s. | 4 inch. 5s. | 5 inch. 6s. | 6 inch. 8s.

1785. Shallow Glass Evaporating Basins (watch-glass form), white French glass 1½ inch, and 2 inches, 1s. *per dozen*.

1786. Hard Bohemian Glass Evaporating Basins, shallow form, ground on the edges to fit in pairs, $1\frac{1}{2}$ inch, 2 inches, $2\frac{1}{2}$ inches, 3s. per dozen.
1787. Clips for holding watch-glasses, in pairs, to protect substances from the air, while being weighed. See page 135.

PORCELAIN EVAPORATING BASINS WITH HANDLES.

Ladles, Pourers, etc.

1788. DRESDEN PORCELAIN EVAPORATING BASINS (Cups or Pourers), with ring handle and large spout, Fig. 1788, serving also for lading acids, pouring mercury into tubes, &c., glazed both inside and outside.



1788.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	6 inches.	26 ounces.	3s. 6d.	4.	$2\frac{3}{4}$ inches.	3 ounces.	8d.
2.	$4\frac{1}{2}$ „	16 „	1s. 6d.	5.	$1\frac{3}{4}$ „	$\frac{1}{2}$ ounce.	7d.
3.	4 „	7 „	1s.				

1789. Berlin Porcelain Pourer, same form as the above, 2 inches diameter, contents 2 ounces, 8d.

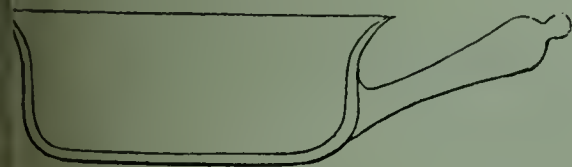
Berlin Porcelain Evaporating Capsules, with spout and handle, in one piece.

No.	Diameter.	Contents.	Price.
1790. No. 0. Fig. 1790.	$1\frac{1}{2}$ inch.	$\frac{1}{4}$ ounce.	3d.
1791. 1. „ 1791.	2 „	1 „	8d.
1792. 2. „ 1791.	$2\frac{3}{4}$ „	$2\frac{1}{2}$ „	9d.
1793. 3. „ 1791.	$3\frac{1}{2}$ „	4 „	10d.



1791.

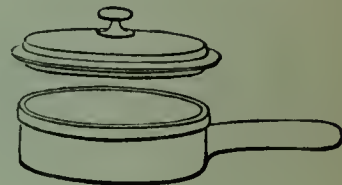
Fig. 1790 represents the actual size of the Capsule.



1790.



1794.



1796.

1794. Thuringian Porcelain Evaporating Basins, with handle in one piece (Ladles) glazed inside and outside, with sharp spouts, Fig. 1794.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	8 inch.	3 pints.	6s. 6d.	3.	$5\frac{1}{2}$ inch.	18 ounces.	3s. 6d.
0.	7 „	2 „	5s. 6d.	4.	$4\frac{1}{2}$ „	12 „	3s.
1.	$6\frac{1}{2}$ „	$1\frac{1}{2}$ „	4s. 6d.	5.	4 „	8 „	2s. 6d.
2.	6 „	$1\frac{1}{4}$ „	4s.	6.	$3\frac{1}{2}$ „	6 „	1s. 9d.

1795. Berlin Semi-Porcelain Evaporating Basins, or Ladles, with spout and handle, in one piece, Fig. 1795, glazed within and without.



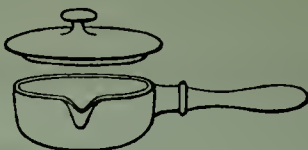
1795.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	3 inch.	4 ounces.	9d.	2.	$4\frac{1}{2}$ inch.	12 ounces.	1s. 6d.
0.	$3\frac{1}{2}$ „	6 „	10d.	3.	$5\frac{1}{4}$ „	20 „	2s.
1.	4 „	8 „	1s.	4.	$6\frac{1}{2}$ „	32 „	3s. 6d.

1796. Thuringian Porcelain Evaporating Basins, cylindrical form, with handle and cover, without spout (stout pans), Fig. 1796.

No. 1.	7½ inch.	2 pints.	5s.	No. 3.	6½ inch.	1 pint.	3s. 6d.
2.	7 „	1½ pint	4s.	4.	5½ „	¾ „	2s. 9d.

1797. Berlin Semi-Porcelain Evaporating Basins or Pans, with cover and wooden handle Fig. 1797.



1797.				1798.			
No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	3 inches.	4 ounces.	1s. 6d.	2.	4½ inches.	12 ounces.	2s. 6d.
0.	3½ „	6 „	1s. 9d.	3.	5¼ „	20 „	3s. 6d.
1.	4 „	8 „	2s.	4.	6½ „	32 „	4s. 6d.

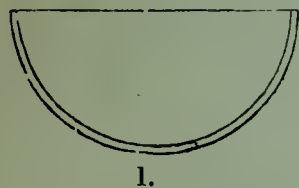
1798. Thuringian Porcelain Evaporating Basins, with spout, and turned wooden handle (ladles), glazed, Fig. 1798. *Two sets as follow:—*

1798. Small Set (4 B).

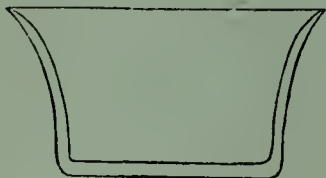
No.	Diameter.	Contents.	Price.
1.	4 inches.	5 ounces.	1s. 8d.
2.	3½ „	4 „	1s. 8d.
3.	3¼ „	3½ „	1s. 6d.
4.	2¾ „	2½ „	1s. 2d.
5.	2½ „	1½ „	1s.

1799. Large Set (6 E).

No.	Diameter.	Contents.	Price.
1.	8 inches.	40 ounces.	5s.
2.	7¼ „	32 „	4s. 6d.
3.	6¼ „	20 „	4s.
4.	5½ „	12 „	3s. 6d.
5.	4¾ „	9 „	2s. 9d.
6.	4¼ „	6 „	2s.



1.



2.



3.



5.



6.



4.



8.



10.



11.



12.



13.



14.

PORCELAIN CUPS.

1800. BERLIN PORCELAIN CUPS, glazed on both sides, serving both for Evaporations and Ignitions.

Any single piece, 3d. The dozen of one kind, or assorted, 2s. 6d.

The thin varieties—such as Nos. 1, 2, 3, 13, 14—may be heated to redness like crucibles. The other kinds are intended only for moderate temperatures, such as the evaporation of solutions to dryness, &c.

No. 1. Hemispherical Capsule, without spout, thin, size of Fig. 1.

See No. 1752 for other sizes of this form of cup.

No. 2. Capsule, size and form of Fig. 2, thin.

3. Small crucible, size and form of Fig. 3.

4. Crucible of the form of Fig. 3, but of the diameter of Fig. 4.

5. Basin of the size and form of Fig. 5.

6. Basin of the form of Fig. 5, but $2\frac{1}{4}$ inches in diameter.

7. Shallow Capsule of the size and form of Fig. 7.

8. Small flat plate of white glazed porcelain with raised rim, for testing solutions which give coloured precipitates, $1\frac{1}{4}$ inch diameter.

9. A similar plate, $1\frac{1}{2}$ inch diameter.

10. Flat bottomed pans, like Fig. 10, from $1\frac{1}{3}$ inch to $1\frac{3}{4}$ inch diameter, for evaporations, or for use as trays for gas tubes.

11. Round bottomed capsules, like Fig. 11, or a form between Figs. 10 and 11, thick in substance, for slow evaporations, size $1\frac{1}{2}$, $1\frac{3}{4}$, and 2 inches diameter.

12. Evaporating Capsules, flat bottoms outside, round inside, thick in metal, Fig. 12, for use in slow evaporations to dryness, size $1\frac{1}{4}$, $1\frac{1}{2}$, and $1\frac{3}{4}$ inch.

13. Very thin crucible without cover, Fig. 13, 1 inch wide and 1 inch deep, for ignitions.

14. Cup and Cover, form and size of Fig. 14, for exposing to ignition substances liable to decrepitation.

15. Small Porcelain Bottle for carrying solution of Nitrate of Cobalt among blowpipe apparatus.



1, 2, 3.

4.

5.

6.

7.

01. DRESDEN PORCELAIN CUPS, serving either for evaporations or ignitions, some of them very thin for weighing, glazed, all without covers.

No. 1. Crucible, form of Fig. 1, very thin, diameter 1 inch, contents 40 grains of water, 3d.

2. Similar, diameter $\frac{5}{8}$ inch, contents 15 grains, 3d.

3. Similar, diameter $\frac{1}{2}$ inch, contents 10 grains, 3d.

4. Plattner's Cup, Fig. 4, very thin, $1\frac{1}{2}$ inch diameter, 1 inch high, contents $\frac{1}{2}$ ounce, 4d.

5. Deep Cups, Fig. 5, see Dresden Digesters, No. 1491, 5 sizes.

6. Cup of the form of Fig. 6, $\frac{3}{4}$ inch deep and 2 inches diameter, contents $\frac{3}{4}$ ounce, 5d.

7. Thin Cup for ignitions, form of Fig. 7, but shallow, $1\frac{1}{2}$ inch deep, 3 inches diameter, holds $2\frac{1}{2}$ ounces, 9d.

8. Similar to 7, 1 inch deep, 2 inches diameter, holds 1 ounce, 4d.

9. Similar to 7, $\frac{5}{8}$ inch deep, $1\frac{1}{4}$ inch diameter, holds $\frac{1}{4}$ ounce, 3d.

10. Plattner's Shallow Pan, for blowpipe experiments, oval form, Fig. 10, 2 inches long, $1\frac{1}{4}$ inch wide, $\frac{1}{2}$ inch deep, holds 3 drachms, 4d.

11. Similar to 10, $1\frac{1}{3}$ inch long, $\frac{3}{4}$ inch wide, $\frac{1}{4}$ inch deep, holds 1 drachm, 3d.

12. Plattner's Digester, for preparing and evaporating Solutions of Minerals for analysis by the blowpipe, Fig. 12, $1\frac{1}{4}$ inch deep, mean diameter $1\frac{3}{4}$ inch, across the mouth $2\frac{1}{4}$ inch, contents $1\frac{1}{4}$ ounce, 7d.

13. Similar to 12, 1 inch deep, mean diameter $1\frac{1}{2}$ inch, across the mouth $1\frac{3}{4}$ inch, contents $\frac{1}{2}$ ounce, 6d.



10.

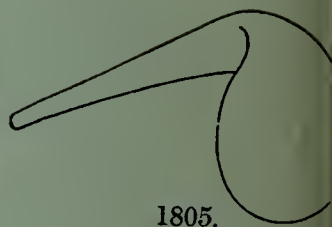


12.

Distillation.

RETORTS.

In general the form of the Retorts is that represented by Figs. 1805 and 1809; but the globular form, Δ Fig. 1810, can also be supplied. The globular form being only required for liquids that rise at a very high temperature, is not so much in request as Retorts of the form represented by Fig. 1805, which sort is consequently the one that is commonly kept in stock.



1805. RETORTS, Plain, Fig. 1805, fine white French glass, free from lead. *Price per dozen* :—

1 ounce, 1s. 2d.	6 ounces, 2s. 6d.	16 ounces, 5s.	2 pints, 9s. 6d.
2 ounces, 1s. 4d.	8 „ 3s.	1 pint, 6s.	2½ „ 10s. 6d.
3 „ 1s. 6d.	10 „ 3s. 6d.	1¼ „ 7s.	3 „ 12s. 6d.
4 „ 2s.	12 „ 4s.	1½ „ 8s.	
5 „ 2s. 3d.	14 „ 4s.	1¾ „ 9s.	

ACID FUNNELS for filling Retorts with liquids without soiling the necks. See 11, 12, Fig. 1598, and Nos. 1942 to 1947.

1806. Retorts, Plain, Fig. 1805, hard white German glass, same quality of glass the fine white Boiling Flasks. *Price* :—

<i>Per dozen.</i>	<i>Per dozen.</i>	<i>Each.</i>
2 ounces, 3s.	14 ounces, 8s.	2½ pints, 1s. 3d.
3 „ 3s.	16 „ 8s.	3 „ 1s. 6d.
4 „ 3s.	1 pint, 9s.	4 „ 1s. 9d.
6 „ 4s.	1¼ „ 10s.	6 „ 2s. 6d.
8 „ 5s.	1½ „ 10s. 6d.	8 „ 3s.
10 „ 6s.	1¾ „ 11s.	12 „ 4s. 6d.
12 „ 7s.	2 pints, 12s.	16 „ 7s. 6d.

1807. Retorts, Plain, of hard white Bohemian glass, the same quality as the best glasses. *Price per dozen* :—

1 ounce, 4s.	5 ounces, 4s. 6d.	10 ounces, 7s.	2 pints, 12s.
2 ounces, 4s.	6 „ 5s.	16 „ 8s.	4 „ 15s.
3 „ 4s.	7 „ 5s.	1 pint, 9s.	6 „ 18s.
4 „ 4s. 6d.	8 „ 6s.	1½ „ 10s.	

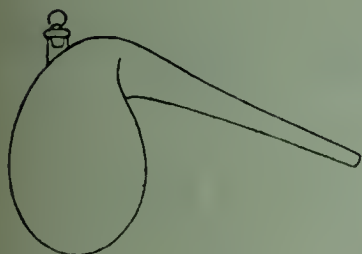
1808. Retorts of Hard Green German Glass.

In consequence of the excellence and the present cheapness of the Retorts made of hard white German and Bohemian glass, those of *green* glass have been omitted from this catalogue; but green Retorts can be supplied if required, at the same prices as white Retorts.

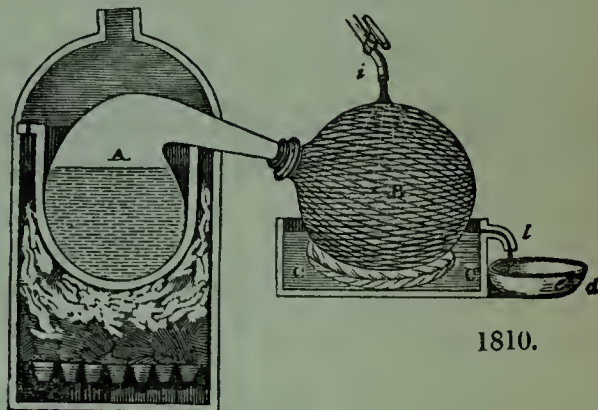
1809. Retorts Tubulated and Stoppered, Fig. 1809; best hard white German or Bohemian glass, same quality as the fine Boiling Flasks and Beakers.

Price per dozen:—

2 ounces, 7s.	12 ounces, 12s.	2 pints, 21s.
3 „ 7s. 6d.	14 „ 13s.	2½ „ 23s.
4 „ 8s.	16 „ 14s.	3 „ 25s.
5 „ 8s.	18 „ 15s.	4 „ 30s.
6 „ 8s. 6d.	1 pint, 16s.	6 „ 36s.
7 „ 8s. 6d.	1¼ „ 17s.	8 „ 45s.
8 „ 9s.	1½ „ 18s.	12 „ 70s.
10 „ 10s. 6d.	1¾ „ 20s.	16 „ 100s.



1809.



1810.

1812. Tubulated and Stoppered RECEIVERS are supplied at the same prices as Retorts of equal capacity. See No. 1847.

1813. Liebig's Retort, with an extra neck, for passing gases over a substance while heated for distillation. Best hard white Bohemian glass.

10 ounces, 1s. 6d.	40 ounces, 2s.	80 ounces, 3s. 6d.
20 „ 1s. 6d.	60 „ 3s.	100 „ 4s.



1813.

1814. Retort of the most infusible Bohemian glass, for exposing substances to a red heat, as for preparing oxygen gas from red oxide of mercury,

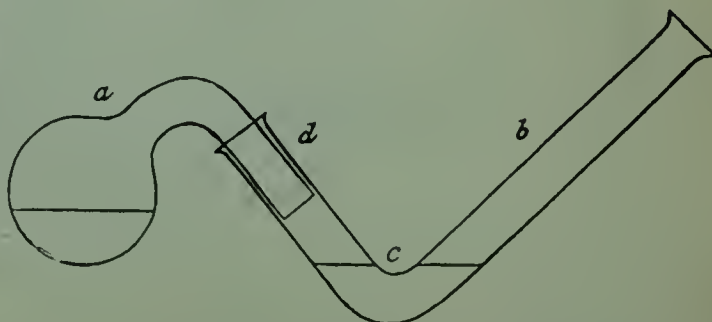
a. 5 ounces, 1s. | b. 10 ounces, 1s. 6d.



1814.

TUBE RETORTS.

1815. Clark's Retort and Receiver, for the distillation and condensation of small quantities of acids, &c., hard glass, diameter of bulb 2 inches, capacity 1½ to 2 ounces, width of neck ¾ inch, length 8 inches, 1s.



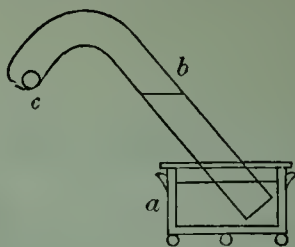
1815.

This apparatus will be found very useful in the distillation of small quantities of liquids, or the preparation of small portions of acids for testing, &c. The retort and the receiver fit closely at d. c is the distilled liquor.

1817. Faraday's Retort and Receiver, in one piece, hard glass, 12 inches long, $\frac{5}{8}$ inch wide, 4d.
 1818. Gay Lussac's Bent Tube Retort, for use when a solid is to be heated in a gas confined over mercury.
 a. 10 inches long, $\frac{1}{2}$ inch diameter, 8d.
 b. 12 inches long, $\frac{3}{4}$ inch diameter, 10d.



1817.



1818.



1819.



1820.

1819. Tube Retorts of hard German glass, slight, either round or pear-shaped form, with narrow necks, useful when the free access of atmospheric air is to be avoided.

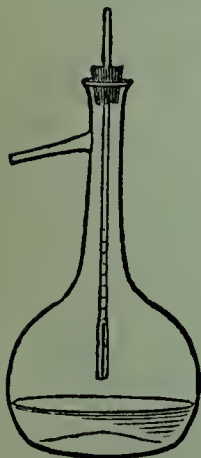
	Contents.	Plain, Fig. 1819.	Tubulated.	Stoppered, Fig. 1820.
a.	$\frac{1}{2}$ to 1 ounce	2d.	3d.	4d.
b.	$1\frac{1}{2}$ to 2 ounces	$2\frac{1}{2}$ d.	$3\frac{1}{2}$ d.	5d.
c.	$2\frac{1}{2}$ to 3 „	3d.	4d.	6d.
d.	$3\frac{1}{2}$ to 4 „	4d.	5d.	7d.
e.	5 to 6 „	5d.	7d.	9d.

For corresponding Receivers, see No. 1853.

1821. Tube Retorts, tubulated and stoppered, with Receivers adapted to the neck grinding.
 2 oz., 9d. | 3 oz., 1s. | 4 oz., 1s. 3d. | 6 oz., 1s. 6d.

FRACTIONAL DISTILLATION.

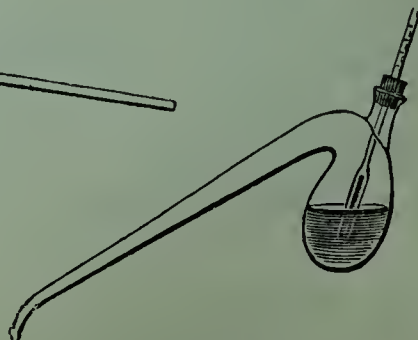
1822. Retorts for Fractional Distillation, small size, of hard German glass, with wide tubulure for thermometer, and bent neck, Fig. 1822.
 $\frac{1}{2}$ ounce, 5d. | 1 ounce, 6d. | 2 ounces, 7d. | 3 ounces, 8d.



1823.



1825.



1822.



1824.

1823. Flask for Fractional Distillation, with long neck to contain an entire thermometer, and a side neck which can be adapted to a Liebig's Condenser, best hard Bohemian glass, Fig. 1823.

a. Contents one pint, 1s. 9d. | *b.* Contents two pints, 2s. 3d.

1824. Oval Flasks for the Fractional Distillation of small quantities of Liquid organic preparations, form of Fig. 1824; the bulb of various capacities, the neck for the thermometer 5 inches long, $\frac{1}{2}$ inch wide; the inclined neck for the Distillate 4 inches long, $\frac{1}{4}$ inch wide.

a. The bulb about 1 inch diameter, or $\frac{1}{2}$ ounce contents, 4d.
b. " " $1\frac{1}{2}$ " " 1 ounce " 5d.
c. " " 2 " " 3 " " 6d.

1825. Condenser for the above distilling apparatus, Fig. 1825, 6d.

This condenser consists of a glass tube, 15 inches long, $\frac{1}{3}$ inch diameter, with a wide neck, to which the delivery tube of the distilling flask is to be connected by a cork. This tube forms a sufficient condenser for some bodies; for others, it can be cooled with a cover of wet calico or filtering paper.

PORCELAIN RETORTS.

826. Retorts of Berlin Porcelain, biscuit outside, glazed inside, five sizes.

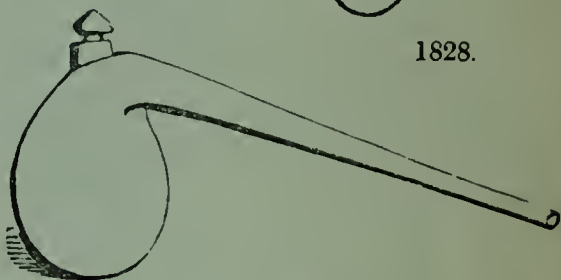
No.	Contents.	Price Plain.	Price Stoppered.
1.	$1\frac{1}{2}$ ounces	2s.	3s.
2.	3 "	3s.	4s. 6d.
3.	6 "	3s. 6d.	6s.
4.	9 "	4s.	7s.
5.	12 "	5s.	8s.



1828.

827. Retort of Berlin Porcelain, globular form, tubulated and stoppered, contents 5 pints, 7s. 6d.

828. Berlin Porcelain Retort, with loose head, to be fixed on with wire and cement (stucco), for the preparation of Ammonia, &c., contents 12 ounces, Fig. 1828, 4s. 6d.



1829.

829. Retorts of Dresden Porcelain.

No.	Contents.	Price Plain.	Price Stoppered.
1.	6 ounces	5s. 6d.	6s.
2.	3 "	4s. 6d.	5s.



1830.

830. Retort, Bohemian Porcelain, biscuit, 6 inches long, $\frac{1}{2}$ inch diameter, Fig. 1830, 1s. 6d.

831. Retorts, Berlin Semi-Porcelain, Stoppered.

2 ounces, 2s.	16 ounces, 4s.	32 ounces, 5s. 6d.
4 " 2s. 6d.	24 " 4s. 6d.	48 " 6s. 6d.
8 " 3s.		

FIRECLAY RETORTS.

1832. Retorts of Infusible Thuringian Stoneware, brown colour.

4 pints, 6s. 6d.	6 pints, 9s.	12 pints, 15s.
5 „ 8s.	8 „ 10s. 6d.	16 „ 20s.

1833. Retorts of Infusible Fireclay, London made.

$\frac{1}{2}$ pint, 1s.	$1\frac{1}{2}$ pint, 2s. 6d.	4 pints, 4s. 6d.
1 „ 1s. 6d.	2 pints, 3s. 6d.	8 „ 6s. 6d.

1833a. Tubulated Retorts, of Fireclay, London made, *each* 6d. more than Plain Retorts.

1834. Retorts of French Fireclay, glazed inside. *Cornues en grès vernis de la fabrique d'Orléans*, form of Fig. 1834.

	Plain.	Tubulated.	Long Tubulure.
a. Contents $\frac{1}{2}$ litre, 1s. 6d.		2s.	3s. 6d.
b. „ 1 „ 2s.		2s. 6d.	5s.
c. „ 2 „ 3s. 6d.		4s. 6d.	7s. 6d.

Can be procured as large as 12 litres ($2\frac{1}{2}$ gallons).

The long tubulure is intended to receive a long tube, as represented in Fig. 1834a, which represents the apparatus for preparing sulphide of carbon.



1834.

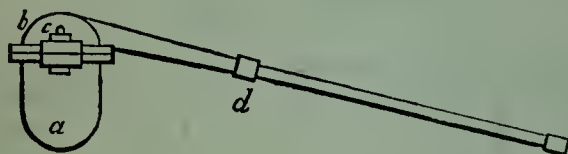
METAL RETORTS.

1837. Retorts of Copper or Iron, for preparing Oxygen Gas. See section on GAS BOTTLES, Nos. 2015, 2022, and 2025.

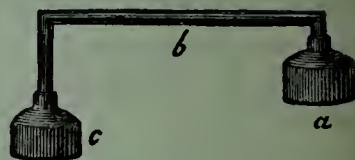
1838. Iron Retorts, for distilling organic matters at a red heat, mercury, &c., with loose head, secured by bolts, with long iron necks to screw on. Fig. 1838. Three sizes:—

Measurement of the body of Retort, inside:—

	Width.	Depth.	Contents.	Price.
1838.	4 inches,	$3\frac{1}{2}$ inches,	1 pint,	8s.
1839.	6 „	$7\frac{1}{2}$ „	5 pints,	18s.
1840.	7 „	9 „	9 „	25s.



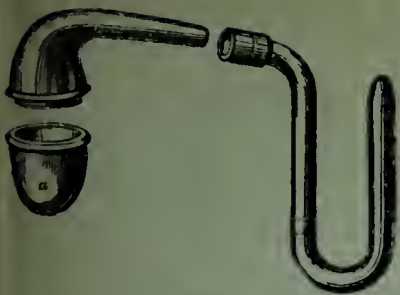
1838.



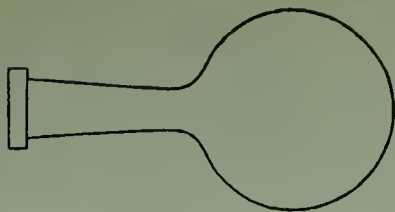
1841.

1841. Lead Retort and Receiver for the preparation of Hydrofluoric Acid, form of Fig. 1841, the Retort *a* and receiver *c*, each $3\frac{1}{2}$ inches diameter; the tube *b*, 1 inches in length, 9s.

1842. Lead Retort and Receiver, larger size, form of Fig. 1842, 30s.



1842.



1846.



1848.

RECEIVERS.

1846. PLAIN RECEIVERS, globular, Fig. 1846, with short wide neck, slightly conical, with welted mouth, ground smooth, French white glass, free from lead.

The SIZES and PRICES are given under the head of FRENCH BALLONS at No. 1405.

1847. Receivers, globular, with short conical neck, and a Tubulure and ground Stopper, placed at right angles to the neck, Fig. 1847, *a*, *b*, and *c*; hard white German or Bohemian glass.

The SIZES and PRICES are the same as the SIZES and PRICES of hard white German and Bohemian stoppered RETORTS. See No. 1809.

1848. Receivers, globular, with one long neck, and a Tubulure, form of Fig. 1848; French or German glass.

These can be supplied of any SIZE, and at PRICES not much differing from those of the SHORT-NECKED RECEIVERS, No. 1847; but these with long necks are not always kept ready in stock, being rarely demanded.



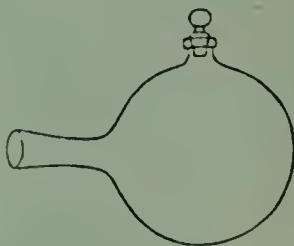
1847a.



1847b.



1849.



1847c.



1850.

1849. RECEIVERS, WITH TWO SHORT NECKS, for use in distillations, in which the products are a Condensible Liquid, and a Gas; see Fig. 1849, *b* in Fig. 1849a, and Fig. 1849b; hard white Bohemian glass.

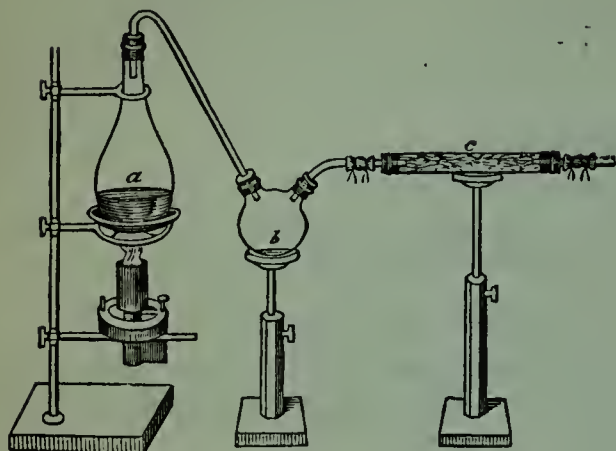
2 ounces, 6d.	6 ounces, 10d.	1 pint, 1s. 6d.
3 " 7d.	8 " 1s.	2 pints, 2s.
4 " 8d.	10 " 1s. 2d.	3 " 2s. 3d.
5 " 9d.	15 " 1s. 4d.	4 " 2s. 6d.

1850. Receivers, globular, with long cylindrical necks, form of Fig. 1850; German glass, white or green.

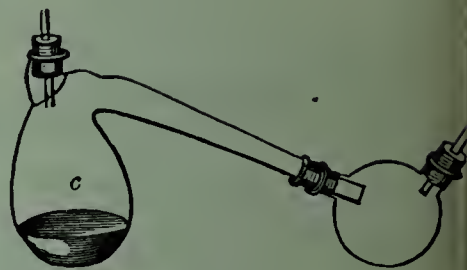
For PRICES and SIZES, see article "BOLT HEADS," Nos. 1411 to 1413.

1851. QUILLED RECEIVER, for use in the distillation of Nitric Acid, &c.; hard white Bohemian glass, stoppered, Fig. 1851.

$\frac{1}{2}$ pint, 2s.	3 pints, 3s. 6d.	7 pints, 5s. 6d.
1 „ 2s. 6d.	4 „ 4s.	8 „ 6s.
2 pints, 3s.	5 „ 4s. 6d.	10 „ 7s.
$2\frac{1}{2}$ „ 3s. 3d.	6 „ 5s.	12 „ 8s.



1849a.



1849b.

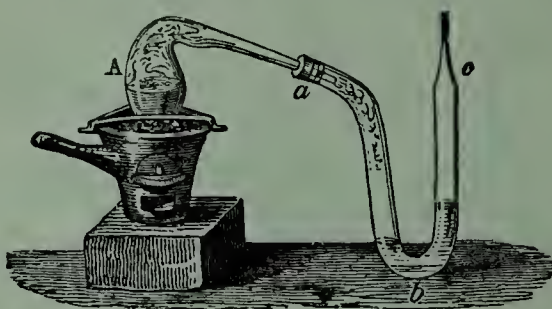
1852. Quilled Receiver of slight blown glass, to use with Tube Retorts, 1 ounce size, 8d.

1853. Receivers, of slight blown glass, adapted to the Slight Tube Retorts, No. 1819, the bulbs either oval or round:—

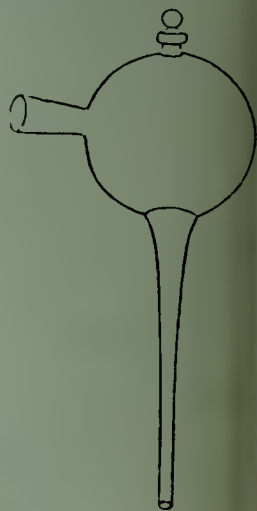
	Contents in ounces.	Plain, Fig. 1419.	Tubulated, Fig. 1853.
a.	$\frac{1}{2}$ to 1	2d.	3d.
b.	$1\frac{1}{2}$ to 2	2d.	$3\frac{1}{2}$ d.
c.	$2\frac{1}{2}$ to 3	$2\frac{1}{2}$ d.	4d.
d.	$3\frac{1}{2}$ to 4	3d.	5d.
e.	5 to 6	4d.	6d.



1853.



1854.



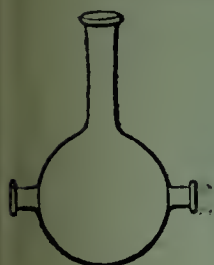
1851.

1854. Bent Glass Tube Receiver, form of a, b, c, Fig. 1854; total length 22 inches diameter 1 inch; 1s. 9d.

Many varieties of bent glass Tube Receivers will be described in the section relating to apparatus for the Collection and Condensation of GASES.

855. Spherical Receivers, with three necks, Fig. 1855 and a Fig. 1856; fine white Bohemian or French glass.

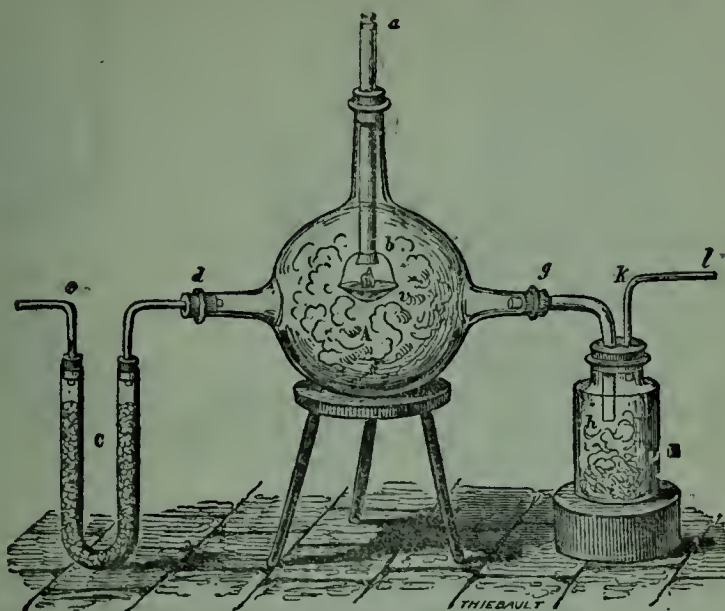
$\frac{1}{2}$ pint, 1s. 4d.	$2\frac{1}{2}$ pints, 2s.	6 pints, 3s.
1 „ 1s. 6d.	3 „ 2s. 3d.	18 „ 10s. 6d.
$1\frac{1}{2}$ „ 1s. 8d.	4 „ 2s. 6d.	24 „ 12s. 6d.
2 pints, 1s. 10d.	5 „ 2s. 9d.	28 „ 15s.



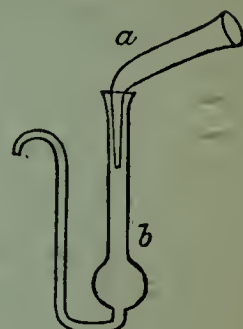
1855.



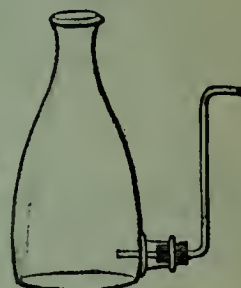
1858.



1856.



1859.



1861.

856 The Apparatus represented by Fig. 1856 is arranged for preparing Anhydrous Phosphoric Acid—see “Chemical Recreations,” page 641. It consists of a spherical flask, or receiver of about 25 pints’ capacity, with three necks, connected with a 30-ounce bottle, and a large U-shaped chloride of calcium tube, 25 inches long by 1 inch diameter; a stool, 8-inch top, 14-inch legs, a straw crown, a set of wooden blocks, Porcelain cup, connected by wires of platinum to a glass tube, and various connections; price 31s. 6d.

857. Receiver, similar in form to the last, but with the addition of a quill, or conical neck below, making in all 4 necks; contents 18 pints, white glass, 12s. 6d.

FLORENTINE RECEIVERS.

For use in the distillation of Volatile Oils, and their separation from Water.

858. FLORENTINE RECEIVERS, for use in the distillation of small quantities, Fig. 1858, 2 ounces, 6d.

859. Florentine Receiver, another form, suitable for small quantities, b Fig. 1859; 4 ounces, 9d.

860. Ditto, with the adapter a, complete, Fig. 1859, 1s. 2d.

861. Florentine Receiver, form of Fig. 1861, best white German glass.

Price with Cork and Tube.

3 pints, 3s. 6d.

4 „ 4s.

5 „ 4s. 6d.

Price Unfitted.

3 pints, 3s.

4 „ 3s. 6d.

5 „ 4s.



1862.

862. Florentine Receiver, fine white Bohemian glass, Fig. 1862, stoppered.

1 pint, 2s.

$1\frac{1}{2}$ „ 2s. 6d.

2 pints, 3s.

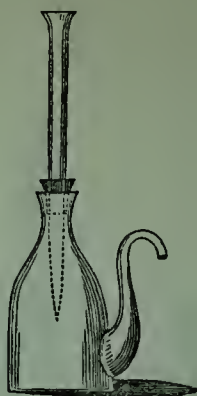
3 „ 3s. 6d.

4 pints, 4s.

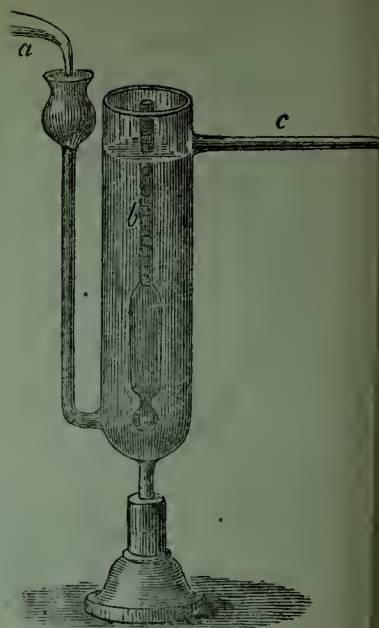
6 „ 5s.

1863 Florentine Receiver, of the form shown by Fig. 1863, having a glass tube in which to separate and collect the distilled oil. *At the same prices as the preceding pattern.*

1864. MOHR'S STILL-WATCHER, for indicating the progress of a distillation, by the density of the liquid given over. The liquor is delivered from the condenser by the bent adapter *a*. It accumulates in the Still-watcher, and its density is tested by the hydrometer *b*. When it rises to the tube *c* it overflows into another vessel. The distillation is stopped when the hydrometer *b* shows that the proper period is reached. On polished wooden foot, 3s.



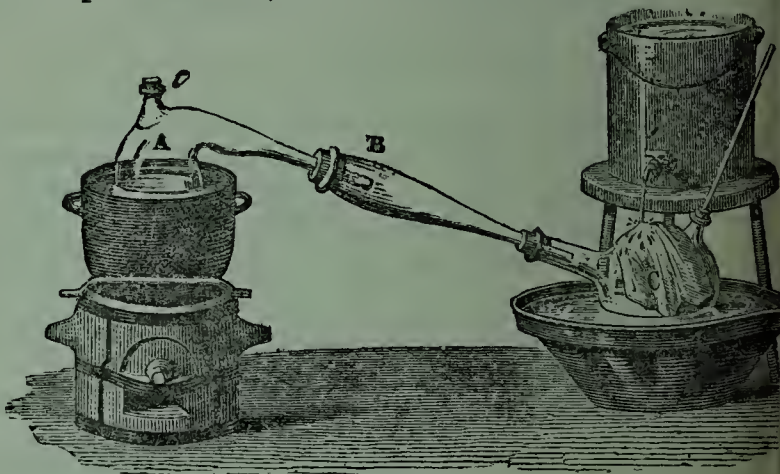
1863.



1864.

ADAPTERS.

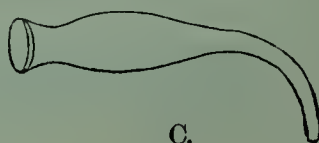
1865. The annexed figure represents a retort A, connected to a receiver C, by means of an Adapter B. This piece is used, sometimes when the neck of the retort is too wide to enter the neck of the receiver; and sometimes to place the receiver at a distance from the heat of the furnace. Adapters are made either bent, like Figs. C and D, or straight, like Figs. A and B; and either with neck, like Figs. A and C, or without neck, like Figs. B and D. These differences in *form* do not affect *price*, which is fixed by the capacity of the receiver, or the width of the wide end, as below:—



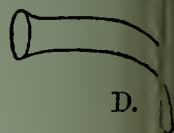
1865A.



A.



C.



D.

1 inch, 8d.

 $1\frac{1}{2}$ inch, 10d.

2 inch, 1s.

 $2\frac{1}{2}$ inch, 1s. 3d.

3 inch, 1s. 6d.

1866. Bent Tube Adapter, D Fig. 1865, *a* Fig. 1859, and *a* Fig. 1866; about 1 inch wide, and 8 or 9 inches long, used to collect the distillate from the point of a Condenser, *f* No. 1873, 6d.

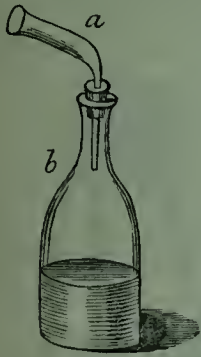
ALEMBICS.

867. ALEMBIC, hard German glass, Fig. 1867, head and body in one piece, the head tubulated:—

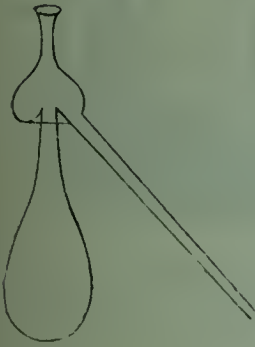
2 ounce, 9d.		3 ounce, 10d.		4 ounce, 1s.
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868. Ditto, in two pieces, the head fitted by grinding, the lower part useful separately as a flask, the head tubulated:—

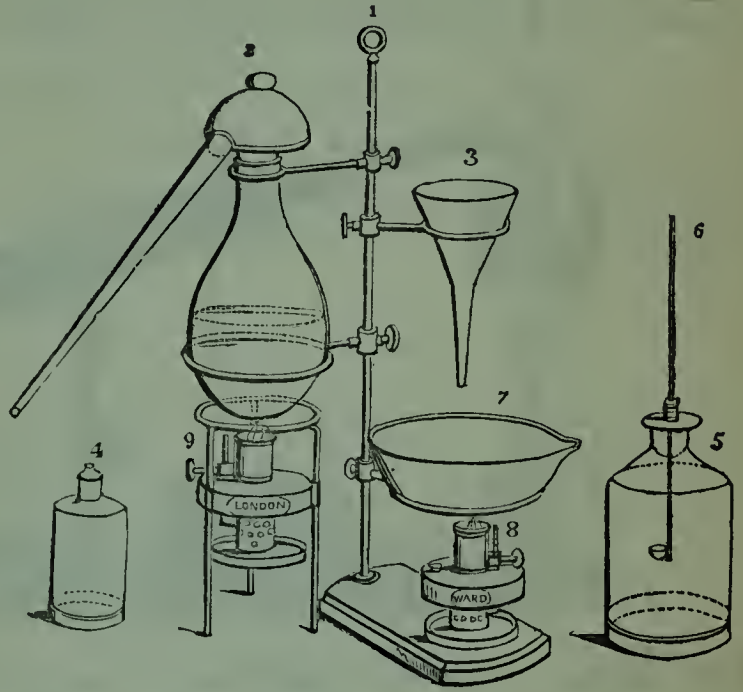
2 ounce, 1s.		3 ounce, 1s. 1d.		4 ounce, 1s. 3d.
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1866.



1867.



1869.

869. Alembics, with separate heads, ground to fit, hard white Bohemian glass, No. 2, Fig. 1869.

$\frac{1}{4}$ pint, 2s. 6d.		2 pints, 6s.		5 pints, 8s.
$\frac{1}{2}$ pint, 3s. 6d.		3 pints, 7s.		6 pints, 9s.
1 pint, 5s.		4 pints, 7s. 6d.		8 pints, 10s.

870. If the head is furnished with a neck and ground stopper, the price is 1s. to 1s. 6d. higher.

871. Alembic, with separate head, stoppered, form of Fig. 1871, Thuringian stoneware, very infusible, brown colour, suitable for the preparation of Ammonia, &c.



1871.



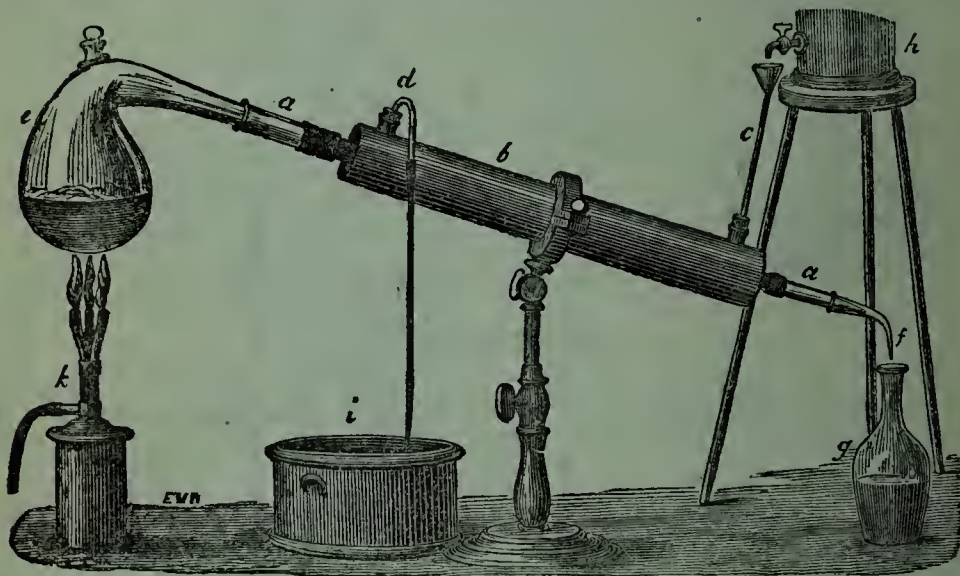
1872.

No.	Contents.	Price.	No.	Contents.	Price.	No.	Contents.	Price.
1.	$\frac{3}{4}$ pint.	7s.	6.	$6\frac{1}{2}$ pints.	14s.	11.	16 pints.	26s.
2.	$1\frac{1}{2}$ pint.	8s.	7.	8 pints.	16s.	12.	20 pints.	30s.
3.	$2\frac{1}{2}$ pints.	9s.	8.	10 pints.	18s.	13.	24 pints.	40s.
4.	$3\frac{1}{2}$ pints.	11s.	9.	12 pints.	21s.			
5.	4 pints.	12s.	10.	14 pints.	24s.			

1872. Alembics of the same material as the foregoing, but of the form of Fig. 187 namely, the body consisting of a wide-mouthed flask, to which the head fitted. The sizes and prices are the same as those of the previous form.

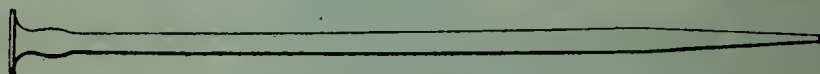
GLASS CONDENSERS FOR USE WITH RETORTS.

When a condenser is used in distillation, the steam given off by a retort or still, passes into a long glass tube, which is surrounded by a wide metal tube, through which runs a constant current of cold water. By this means the steam is condensed into a liquid very conveniently and completely. Wherever it is possible, the pipe marked *c*, Fig. 1873, should be connected with a large water cistern, and the pipe *d* with a waste pipe or drain. The condensation then proceeds in the most effective manner, without demanding much attention from the operator. When a constant flow of cold water is not at command, the operator must use water bottles as represented in the figure.



1873.

1873. Apparatus for the Distillation of Acids, of Alcohol from Wines, &c., consisting of a 40 ounce stoppered retort, a glass Liebig's condenser, measuring 36 inches by 1 inch, round japanned tin case, black wood support with universal joint, and an adapter, 14s., Fig. 1873, *a, b, c, d, e, f*.



1874.

The prices of the above apparatus, separately, are as follow:—

1874. The Glass Condensing Tube, Fig. *a a*, and Fig. 1874. The following sizes:

- a.* 30 inches long, $\frac{3}{4}$ inch diameter, 1s. 6d.
- b.* 36 inches long, $\frac{1}{2}$ inch „ 1s. 6d.
- c.* 36 inches long, 1 inch „ 2s.
- d.* 40 inches long, $1\frac{1}{2}$ inch „ 2s. 6d.
- e.* 40 inches long, 2 inches „ 3s.

1875. The Glass Condensing Tube with its metal case, Fig. 1873, *a* to *d*, 6s.

1876. The Support with universal joint, polished blackwood, 6s.

1877. The Support of mahogany, polished, 9s. 6d.

1878. The other parts of this apparatus have been priced elsewhere.

f. Bent tube Adapter, No. 1866.

g. Vertical Receiver, No. 1575.

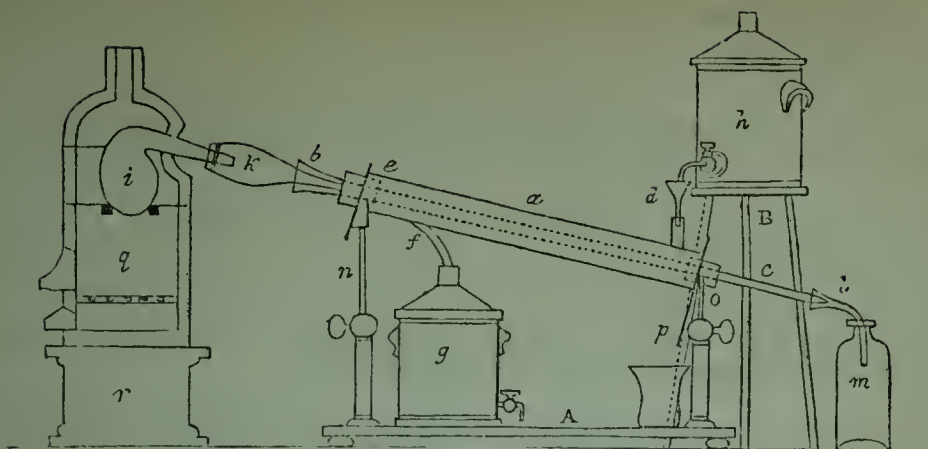
h. Stoneware Water Bottle, No. 246.

i. Pneumatic Trough, cylindrical form, No. 2066.

k. Bunsen's Gas Burner, 3 jets, No. 959.

The Gas Burner is supported on a round wooden block, No. 393.

The Water Bottle is supported on a stool with three legs, No. 406, 2.



1879.

1879. Glass Condenser, mounted in a large triangular metal case, which contains a considerable quantity of water, and ensures more perfect condensation, Fig. 1879.

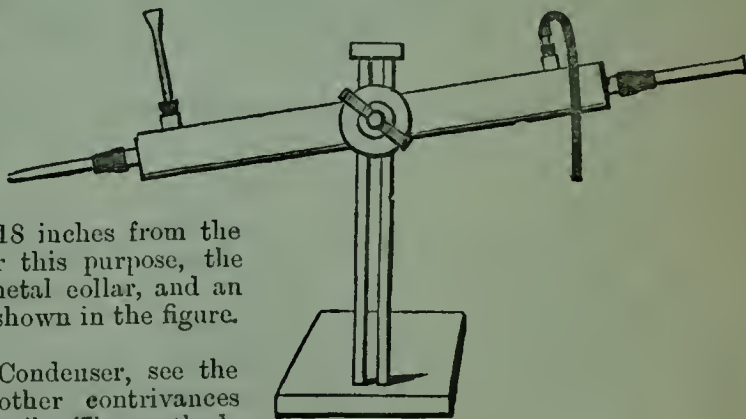
- a. Price of the Condenser, a, b, c, d, e, f, 8s. } complete, 16s.
 b. Price of the Support, A, n, o, 8s.

Description of Figure.—a. Condenser tube, japanned zinc, 28 inches long; b, c, glass tube, 36 inches long; d, funnel by which cold water runs in from the water bottle, h; e, pipe by which warm water escapes through f into the bottle g; i, retort; k, adapter (See No. 1865) connecting the retort with the condenser; l, adapter, connecting the condenser with the bottle m; A, black wooden vessel, with moveable arms, n, o, for supporting and adjusting the height of the condenser; B, wooden stool for supporting the water bottle (the legs unscrew for travelling); q, table furnace; r, support for the furnace; p, gutter for carrying off water that overflows the funnel d, and preventing its escape along the pipe c.

The prices of the other articles will be found under their respective heads, viz. g, h, water bottles, No. 246; i, plain retort, No. 1805; k, adapter, No. 1865; l, adapter, No. 1866; q, furnace, No. 790; r, furnace foot, No. 798; B, stool, No. 406.

880. Condenser with Müller's Support, of the form of Fig. 1880, 14s.

Description.—This Support consists of two square parallel bars made of polished black wood, mounted on a wooden base. The condenser can be fixed by it at any height not above 18 inches from the table, and at any required angle. For this purpose, the condenser tube is furnished with a metal collar, and an arm, and the thumb screw and fittings shown in the figure.



1880.

For other methods of supporting a Condenser, see the Collar, No. 285, and various other contrivances described in the section on "Supports." The methods described in this section are such as are best adapted for frequent use.

81. Condenser Tube, hard German glass, fitted in a glass envelope, Fig. 1881. The inner tube 36 inches long, $\frac{1}{2}$ inch diameter. The outer tube 24 inches long, 1 inch diameter. The apparatus complete, fitted with corks, but without caoutchouc tubes, 4s. 6d.



1881.

a. The inner tube of the Condenser, No. 1881, alone, 1s. 6d.

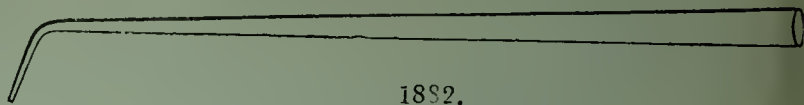
b. The outer tube alone, 2s. 6d.

The necks on the outer tube are made very short in order not to be readily broken off. It is convenient to have one of these necks fitted to a water pipe with a constant supply, and the other connected with a waste pipe, the connections being made with caoutchouc tubes.

1882 Condenser Tube, hard

German glass, form of Fig. 1882, four feet long, diameter

of the wide end, 2 inches, length of the bent end, 6 inches, of very stout glass, well annealed, the tube alone, price 3s.



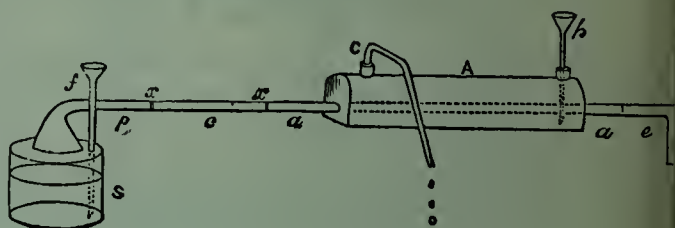
1882.

1883. Ditto, the tube mounted in a japanned zinc case, similar to that represented by b, c, d, Fig. 1873, length of case, 32 inches, diameter $3\frac{1}{4}$ inches, price 9s.

1884. Condenser Tube, of the form of Fig. 1882, but 5 feet long, 3s. 6d.

METAL STILLS AND CONDENSERS.

1886. Tinplate Still, for preparing pure water, half-gallon size, adapted to an ordinary kitchen fire-place, with Liebig's condenser, containing a block-tin pipe, 12s.

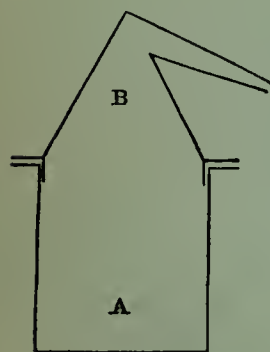


1886.

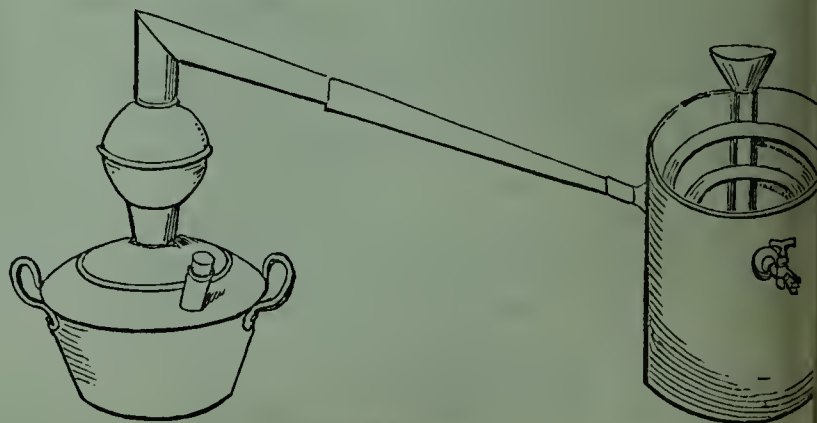
Description.—S, a tinplate still of the capacity of two quarts; p, a, e, a block tin pipe; A, a japanned tinplate or zinc condenser, into which water is to be run constantly by the pipe h, and from which the warm water escapes by the water-pipe c. The cold water may be supplied from a water bottle, No. 24. Whenever steam issues from the funnel f, more water must be poured into the still.

1887. Tinplate Still, for the distillation of water, alcohol, or volatile oils; one pint capacity, Fig. 1887, adapted to the cylinder b Fig. 1191, of Griffin's Lamp Furnace, 2s.

1888. The same in a single piece, tubulated at the top, 1s. 6d.



1887.



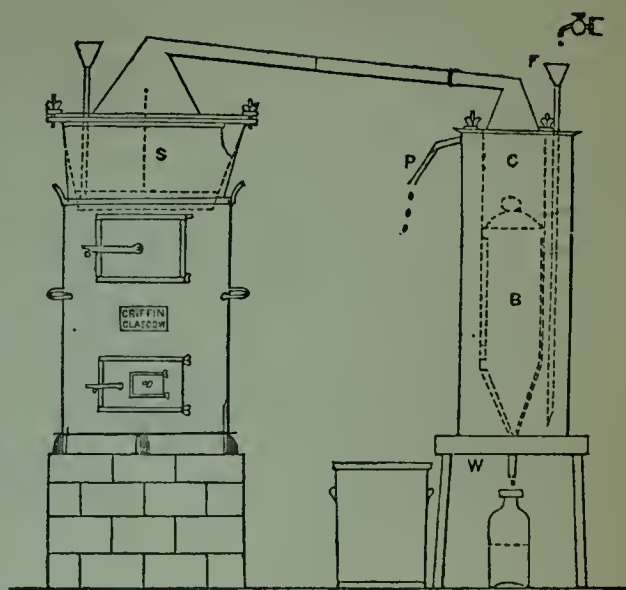
1889.

1889. Tinplate Still, for the distillation of water, with warm tub complete, one-gallon size, Fig. 1889, 14s.

1890. Ditto, two gallons, with warm tub, 22s.

1891. STILLS, adapted to PORTABLE CHARCOAL FURNACES such as Luhme's Furnaces, No. 772.

Description.—The apparatus represented by Fig. 1891 is applicable, not only to the distillation of water, but to that of volatile oils, rose water, lavender water, &c. It presents the great advantage over many forms of distilling apparatus, that every part of the interior, both of the Still and the Condenser, can be readily got at for the purpose of thorough cleaning. The STILL, S, has a moveable head, which can be fastened on by five screws, a washer of many folds of filtering paper being placed on a broad flange between the head and the Still. There is also a moveable pierced false bottom, which is only used in the distillation of volatile oils, the use of it being to prevent rose leaves, &c., from touching the bottom of the Still, to sodden in the water, or to suffer from burning. The heat is supplied by a PORTABLE IRON FURNACE, fed with charcoal. An iron jacket is put upon the furnace round the still, to prevent the loss of heat by radiation. The carbonic acid of the fire escapes by a large hole in the upper part of this jacket.



1891.

The CONDENSER, C, consists of a hollow cylindrical body, the two concentric walls of which form a space that is kept continually full of cold water. This is supplied from a Water Bottle, No. 246, by the funnel F, and the warm water flows away by the waste pipe, P. The head of the Condenser is separate from the body, and fastened on by screw nuts, in the same manner as the head of the Still. The steam passes from the Still directly into the cavity, C, of the Condenser, where it comes into contact with the circular cistern containing the cold water, close against which it is pressed by the solid block, B, which allows only one quarter of an inch of space all round for the steam to pass by; and as the steam comes at the bottom into contact with the coldest water issuing continually from the lower end of the long funnel, R, it is effectually condensed, and flows out of the pipe, W, in the state of water, more or less warm according to the more or less effective state of the condensing power. In adjusting the apparatus for use, the Condenser is first mounted on a three-legged stool, having a hole in the centre of the top for the reception of the delivery pipe, W. The furnace is then brought to a proper level by means of a stack of loose bricks. With this apparatus several gallons of distilled water may be prepared in a day. When a distillation is ended, all the vessels should be emptied, washed, and dried without delay, to prevent their becoming rusty. The outside of the Condenser is japanned.

Prices of the STILLS:—

1892. One gallon, tinplate, 10s.

1893. Ditto, copper, 25s.

1894. Two gallons, tinplate, 20s.

1895. Ditto, copper, 40s.

Iron Jacket, to suspend the still over the furnace:—

1896. For a One gallon Still, 4s.

1897. For a Two gallon Still, 6s.

1898. VERTICAL CONDENSERS, for use with the one-gallon and two-gallon Stills, so constructed that they can be opened and cleaned inside. See Fig. 1891, and description of that article.

1898. Condenser for use with the One-gallon Still, 14s.

1899. „ „ Two-gallon „ 16s.

900. Wooden Stool for the Condenser, see W, Fig. 1891, 2s. 6d.

PORTABLE FURNACES, with this DISTILLING APPARATUS COMPLETE, comprehending Luhme's Furnace, No. 773, second size, Fig. 772b, with a One-gallon Still and Jacket, the Condenser, No. 1898, and a Stool.

901. With a tinplate Still, £2 18s. 6d.

1902. With a copper Still, £3 13s. 6d.

" Similar Furnace and Distilling Apparatus complete, but with the Furnace No. 773, third size, a Two-gallon Still, the Condenser, No. 1899, and a Stool.

1903. With a tinplate Still, £4.

1904. With a copper Still, £5.

GAS FURNACE, with DISTILLING APPARATUS, complete. The furnace consists of a sheet iron jacket, on a tripod of the same character as that described at No. 1914. The gas burner is No. 974; the still, condenser, and stool the same as those described at Nos. 1891 to 1900.

Prices according to the size and metal of the Still ;—

1905. The Still of tin-plate, one gallon, 42s.

1906. The Still of copper, one gallon, 57s.

1907. The Still of tin-plate, two gallons, 60s.

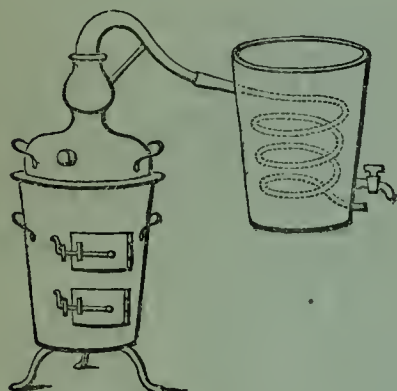
1908. The Still of copper, two gallons, 80s.

1909. PORTABLE STILL, WITH FURNACE, form of Fig. 1909, substantially made. The

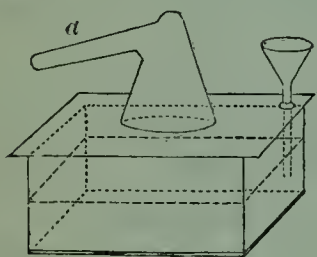
Stills of copper, with block-tin head; the Worm of block-tin; the Furnace of iron, and the Worm-tub of galvanized iron.

The following sizes :—

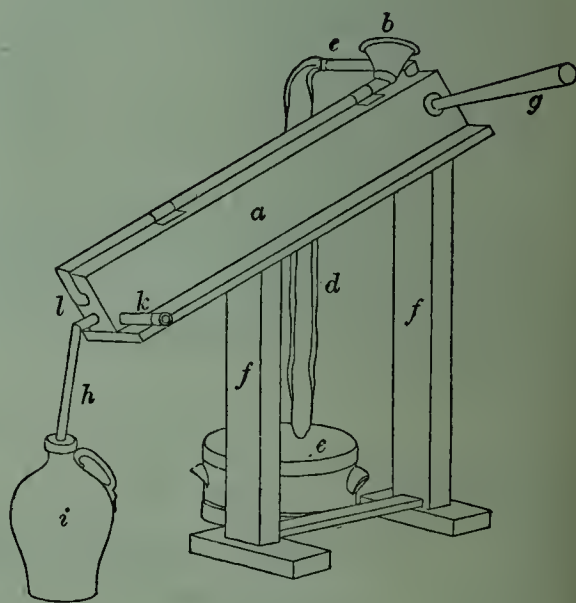
1 gallon, £6	4 gallons, £9	8 gallons, £14 14s.
2 „ 6 10s.	5 „ 10 10s.	10 „ 18
3 „ 7 10s.	6 „ 12	12 „ 20



1909.



1912.



1913.

1912. Tinplate Still, 12 inches square, 6 inches deep, with the most approved form of head, Fig. 1912, 10s. 6d.

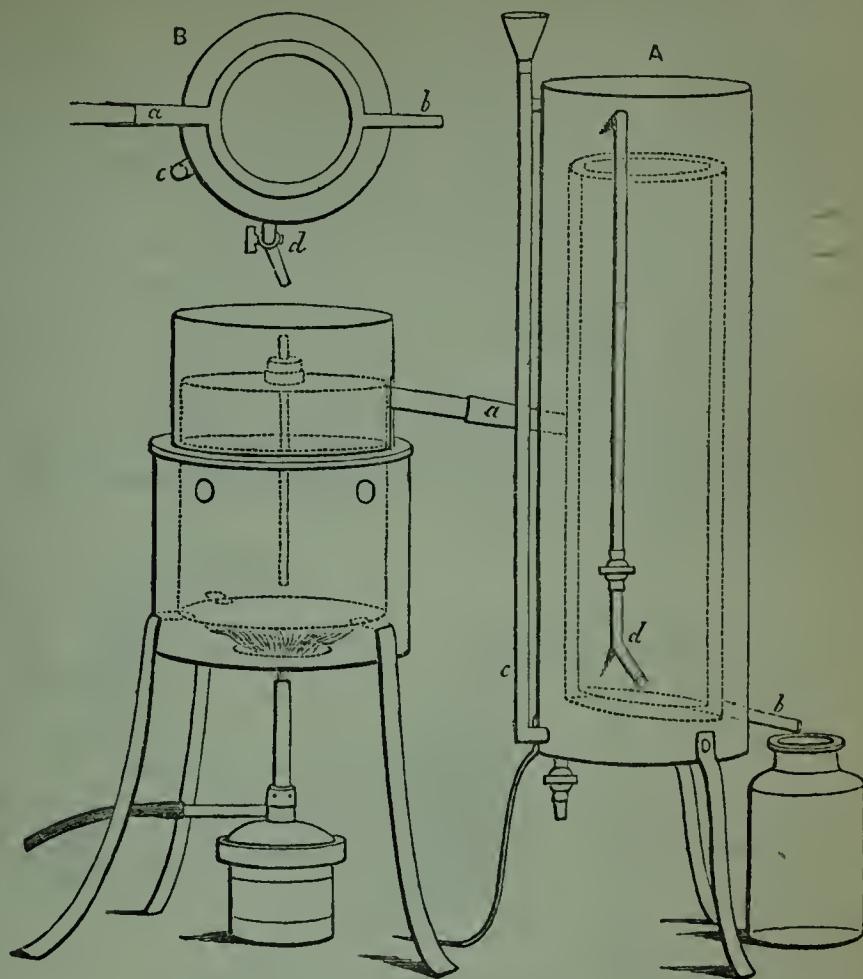
This may be used over a portable furnace or common fire, but acts best when set in a brick furnace, with all the bottom and half the sides exposed to the fire, being supported by the rim alone. The funnel pipe serves to give notice when the water is boiled down below the end of it. With this Still, and the Condenser, No. 1913, many gallons of distilled water may be prepared in a day with a coal fire, at a small expense.

1913. Condenser, Fig. 1913, adapted for use with the Still, No. 1912, made of japanned tinplate, price, complete, but without the support *f*, 16s.

It consists of two vessels, viz., an outer vessel, *a*, 3 feet long, into which cold water passes by the tube, *b*, *l*; and when warm, escapes by the pipe *c*, and the cloth tube *d*, into a bottle or part. The inner steam vessel is of nearly the shape of the outer vessel *a*. It is connected by the pipe, *g*, with the neck of the Still; it is of a taper form, and terminates in the pipe *h*, where the condensed liquor passes into the bottle *i*. The pipe *k* is intended to run off the condensing water when the apparatus is not in use; *f* is a wooden tressel by which the condenser is supported at an angle of about 30°.

1914. DISTILLATION OF WATER BY MEANS OF A STILL, HEATED BY A GAS BURNER. The Still, Furnace, and Condenser, as represented by Fig. 1914. Price 45s.

Description.—The Still or Boiler is a cylinder of tinplate, measuring 9 inches in height, and 8 inches in diameter. It has a wide neck at the top, which can be closed by a cork carrying a glass tube that dips nearly to the bottom of the still, and is open at both ends. The steam pipe issues from the side of the still near the top, as represented at *a* in the Figure. The still is suspended on brackets in a stout plate-iron furnace, mounted on legs. The diameter of the furnace is 10 inches, its height is 7 inches, and its legs are 13 inches high. The Still is covered by an iron dome, which serves to prevent the too early condensation of the steam. The capacity of the still is 3 pints, but it should not be worked with more than 2 pints of water at once. It is convenient to distil off 6 pints, and then to put 6 more pints into the Still and continue the process. The quantity of water contained in the Still can at any time be found by using the glass tube as a pipette. The Still can be cleaned by inserting a bottle brush through the neck at the top.



1914.

The Heat is supplied by one of the Gas Burners, No. 973, 974, or 975, used without the rose. A round opening in the bottom of the furnace admits the flame, which is to be made to play directly upon the bottom of the Still. The necessary draught is obtained by several holes punched near the upper edge of the iron furnace, two of which holes are represented in the figure.

The Condenser consists of a double cylinder of tinplate, mounted within a cylinder of zinc, which acts as the water cistern. Fig. A is a perspective view of the Condenser, and Fig. B is a cross section. The zinc cylinder measures 26 inches in height, and 8 inches in diameter. The legs are 13 inches high. The double tinplate steam cylinder is 21 inches high, 6 inches across outside, and 5 inches inside. The space between the two cylinders is half an inch. There is an inch of cold water between the outside of the steam cylinder and the zinc cylinder, and the 5-inch space in the middle of the steam cylinder is full of cold water, this space being open at both ends. The steam passes from the Still to the condensing cylinder by the pipe *a*, and the distilled water escapes by the pipe *b*, into the bottle placed to receive it. The Still and Condenser are placed about 10 inches apart.

The condensing water is supplied by the pipe *c*, being poured into the funnel at the top of that pipe, and entering the zinc cylinder at the bottom. In proportion as the water is heated by the steam it rises to the upper part of the cistern, the tall form of which is favourable to that object. The zinc cistern is filled with cold water to the top, and when the water is warm it is run off by the pipe *d*, which is provided with a stopcock at the lower end. If, at any time, warm water is required, it can be obtained from this source, cold water being supplied at the same time by the funnel at *c*. There is a cover to keep dust out of the cistern.

With this apparatus, the product of distilled water depends upon the amount of heat supplied, and the due supply of condensing water:—

The Burner, No. 973,	distils 1	Pint	of Water per Hour.
The Burner, No. 974,	„	2½	Pints „ „
The Burner, No. 975,	„	5	Pints „ „

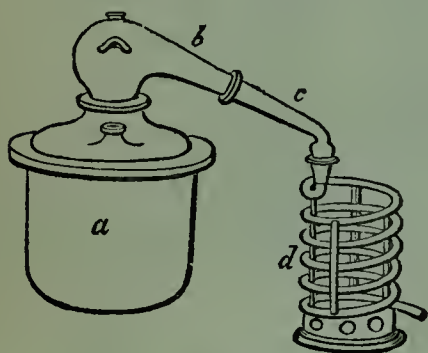
When No. 973 is used, the condensing water does not require to be changed. With No. 974 it must be changed at least once in the hour. With No. 975, it must be changed every half-hour. When the operator has at command a constant flow of water, the supply pipe may be attached to the condenser pipe *c*, after removing the funnel, and the discharge pipe *d*, may be connected with a drain. In that case, the condensation will be very effectual, and the largest gas burner may be used. But to provide against any accidental stoppage of the pipes, the top of the zinc cistern, *A*, should be closed water-tight; otherwise a troublesome overflow of water may occur.

The small stopcock represented at the bottom of the Condenser is for drawing off the condensing water, and is especially useful when the apparatus is to be cleaned.

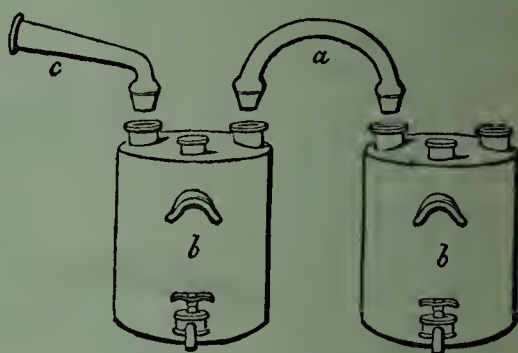
As the Boiler of this apparatus can be easily separated from the Condenser, the steam it supplies can be used for Boiling, Evaporating, and other processes. The entire apparatus, as represented by Fig. 1914, occupies a table space of 15 inches by 30 inches. It may, with little attention, be kept in constant action, and it can be readily dismantled, dried, and put aside.

1915. Distilling Apparatus, similar to No. 1914, but in which the Boiler and Steam Cylinder are made of Copper instead of Tinplate; the other parts as described above. Price £4.

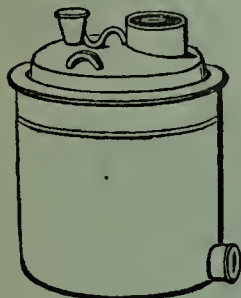
1918. RETORTS, STILLS, and RECEIVERS, for the Distillation of Mineral Acids, Chlorine Gas, and other corrosive chemicals in large quantities, made of salt-glazed Stoneware, warranted to resist the strongest acids. They can be made of any desired capacity.



1918.



1919.



1920.



1923.



1922.



1921.

Fig. 1918 represents an Acid Retort *a*, with a Still Head *b*, Dip-arm *c*, and Worm *d*. Fig. 1919 represents two Receivers, *b, b*; a Connecting pipe *a*, a Dip-arm *c*, and stopcocks in the Receivers. Fig. 1920 is a Chlorine gas retort. Fig. 1921, a Jar for storing acids. Fig. 1922, a False arm. Fig. 1923, a Stopcock. The prices of the several articles are as follow:—

1919. Retorts, Receivers, Chlorine Retorts, and Store Jars, Figs. 1918, 1919, 1920, and 1921, up to 20 gallons contents, at 1s. 6d. per gallon. Every gallon in excess of 20 gallons, at 2s. 3d. per gallon.

1920. Still Heads, *b* Fig. 1918, at 1s. 9d. per inch, measured where they fit up to the Still or Retort (out to out).

1921. Dip Arms, *c* Fig. 1918 and 1919, price according to their length:—

12 inch, 2s. 3d.	20 inch, 4s. 6d.	30 inch, 7s. 6d.	48 inch, 12s.
16 „ 3s. 9d.	24 „ 6s.	36 „ 9s.	60 „ 15s.

1922. False Arms, Fig. 1922, price according to their length:—

12 inch, 1s. 6d.	20 inch, 3s. 9d.	30 inch, 5s. 3d.
16 „ 3s.	24 „ 4s. 6d.	36 „ 7s. 6d.

1923. Stone Cocks, Fig. 1923.

$\frac{1}{4}$ inch, 3s.	$\frac{3}{4}$ inch, 6s.	$1\frac{1}{4}$ inch, 16s.	2 inch, 36s.
$\frac{1}{2}$ „ 3s. 9d.	1 „ 11s.	$1\frac{1}{2}$ „ 22s. 6d.	$2\frac{1}{2}$ „ 60s.

1924. Grinding Cocks to fit vessels, 1s. 6d. each.

1925. Connecting Pipes, *a* Fig. 1919, for clay lute.

$2\frac{1}{2}$ inch, 3s. 9d.	3 inch, 5s. 3d.	4 inch, 7s. 6d.
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1926. Connecting Pipes, for water lute.

$2\frac{1}{2}$ inch, 4s. 6d.	3 inch, 6s.	4 inch, 7s. 6d.
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1927. Condensing Worms, *d* Fig. 1918.

No.	Height.	Diameter.	Bore.	Price.	No.	Height.	Diameter.	Bore.	Price.
1.	18 inch.	9 inch.	$\frac{3}{8}$ inch.	15s.	4.	40 inch.	24 inch.	$1\frac{1}{2}$ inch.	£4 14s. 6d.
2.	25 „	14 „	$\frac{3}{4}$ „	31s. 6d.	5.	45 „	26 „	2 „	£6 6s.
3.	30 „	18 „	1 „	£3 3s.	6.	50 „	27 „	$2\frac{1}{2}$ „	£7 17s. 6d.

The prices do not include Worm Tubes.

1928. Acid Jugs with spout and handle.

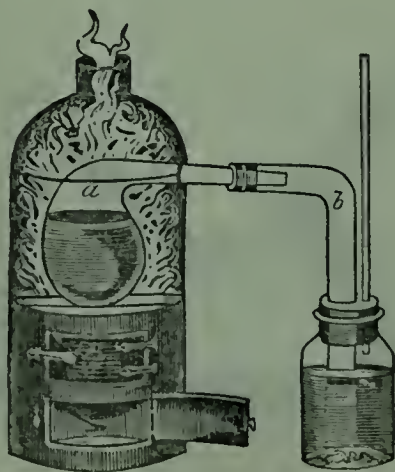
2 Pints, 6d.	4 Pints, 1s.	1 Gallon and upwards at
3 „ 9d.	6 „ 1s. 2d.	1s. 3d. per Gallon.

GAUGE TUBES.

1929. Bohemian Glass Tubes for Steam-engine Boiler gauges, of infusible well-annealed glass, capable of enduring sudden changes of temperature without cracking; substance of the glass $\frac{1}{16}$ inch to $\frac{1}{8}$ inch.

a. Any length from 12 to 15 inches, and $\frac{1}{2}$ inch to $\frac{5}{8}$ inch outside diameter, per dozen, 6s.

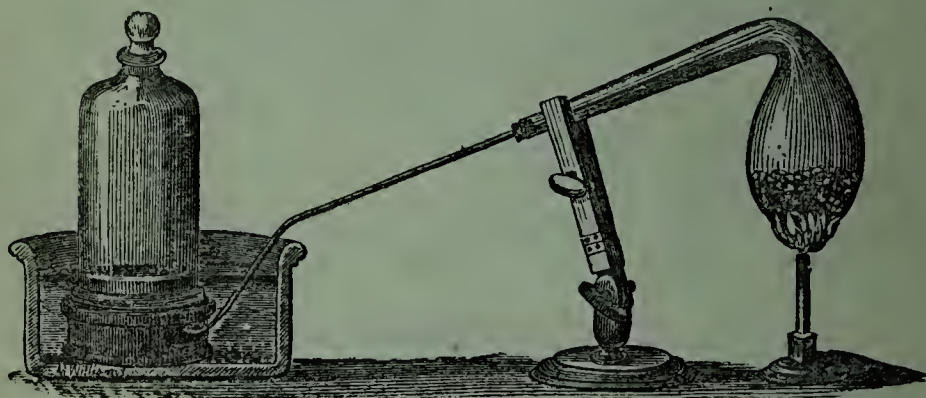
b. Any length from 16 to 18 inches, and $\frac{1}{2}$ inch to $\frac{5}{8}$ inch outside diameter, per dozen, 7s.



DISTILLATION OF PHOSPHORUS.

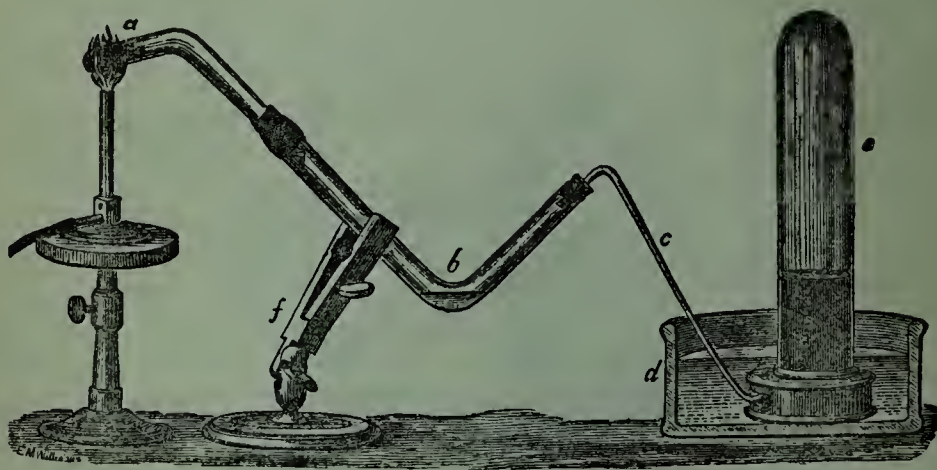
The Preparation and Examination of Gases.

1935. The following four Figures exhibit several of the peculiarities which demand attention in the selection and adjustment of apparatus for the preparation and collection of gases.



1935.

Fig. 1935 represents the preparation of oxygen gas, by heating a dry powder in a retort. The heat is supplied by a gas burner. The retort is supported by a wooden holder. These two articles are described under their proper heads. The gas is delivered by a conducting tube from the retort into a bee-hive shelf placed under water in a pneumatic trough. It rises thence into a glass receiver which stands on the bee-hive shelf.

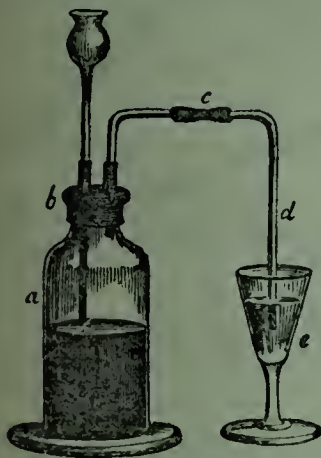


1936.

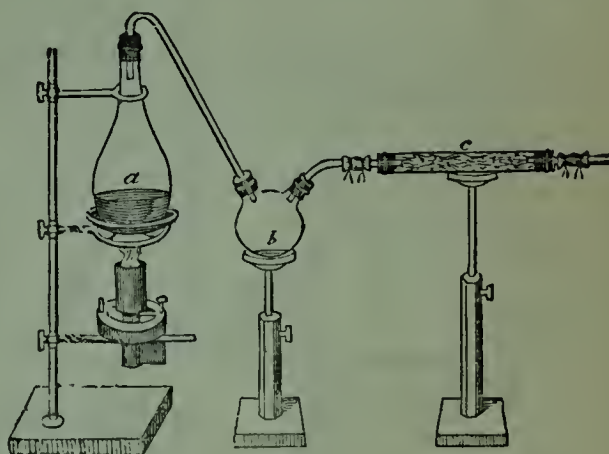
Fig. 1936 represents the preparation of coal gas by the distillation of coal. The retort used here, *a*, is a bent tube of hard glass. This is connected with another bent tube *b*, in which the gas deposits a liquid which distills with it from the coal. The gas is then carried by the tube *c* into the receiver *e* through the trough *d*. The tube *a* is connected to *b* by a caoutchouc tube, and *b* is connected to *c* by a perforated cork.

Fig. 1937 represents the production of a gas (sulphuretted hydrogen) without the application of heat, by the action of a liquid acid upon a solid substance placed in the bottle *a*. To regulate the action, water is first put into the bottle, and then the acid is added, a little at a time, by the tube funnel. The gas passes by the tubes *c*, *d* into the liquid contained in the test glass *e*, upon which the gas is to exercise its chemical action. At *b* is shown a caoutchouc cap which is large enough to cover the neck of the bottle, and which has two tubes for the passage of the glass tubes. At *c* is a short caoutchouc tube for the connection of the two gas-leading tubes.

Fig. 1938 represents the production and purification of chlorine gas. The gas is produced in the flask *a*, where heat is applied to a suitable mixture. It is then passed into the intermediate receiver *b*, where it deposits any liquid acid that it may carry over with it mechanically. It then passes through the tube *c*, which contains a substance that deprives the gas of moisture, so that the gas issues from that tube in a pure and dry state.



1937.



1938.

From these Figures it will be seen that this subject requires the consideration of the proper forms of gas bottles to be used with or without the application of heat, and of gas-leading tubes, caoutchouc and other fittings, gas receivers, pneumatic troughs, gas holders, vessels to contain purifying and drying substances, vessels to measure gases, &c.; all of which articles will now be classed in groups and described. As the different kinds of supports for the apparatus, and the methods of producing and applying heat, have been already described, those subjects will be passed over without notice.

GAS BOTTLES AND THEIR FITTINGS.

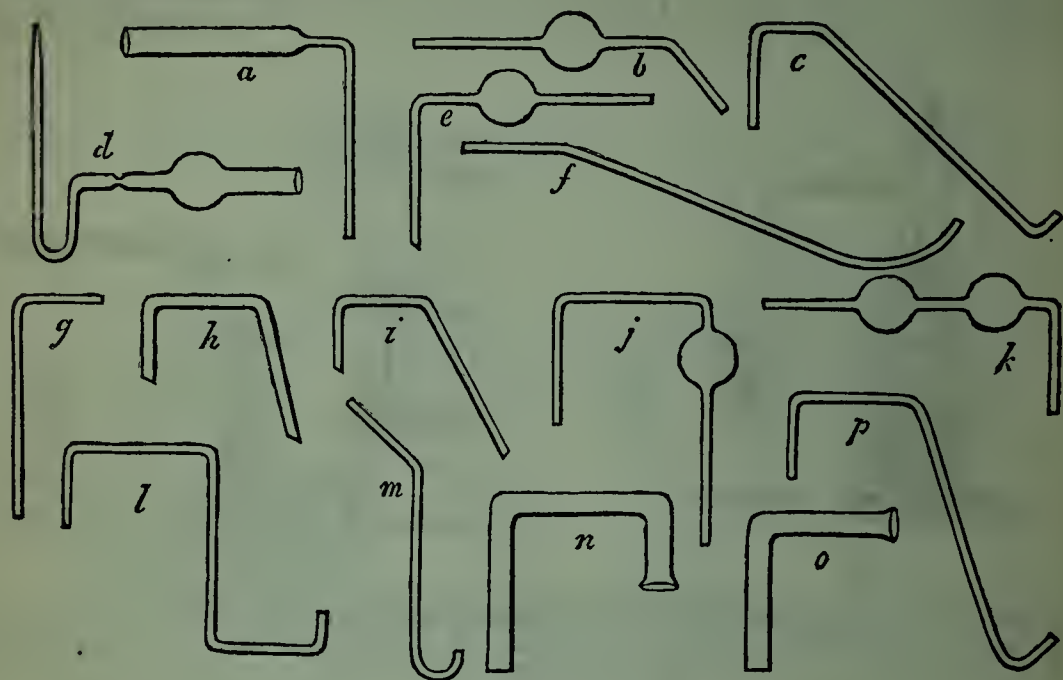
CHOICE OF FLASKS FOR PREPARING GASES.

1939. Any of the flasks described between Nos. 1400 and 1427 may be used for preparing gases, provided the mouths are sufficiently round to be securely closed by corks or caoutchouc caps. Of course, when two or three tubes have to pass through one cork, the flask must be chosen with a wide mouth. In cases where heat is not to be applied, cylindrical wide-mouthed bottles, such as those described at No. 1575, may be used. Wide-mouthed bottles are also desirable, when large quantities of solid materials have to be put into them, or when the residue of the operation is solid or subject to crystallise readily. In many operations it is useful to employ Woulff's bottles, with two or three necks, all of which can be closed very accurately with corks or caoutchouc stoppers, carrying acid funnels, gas-leading tubes, and the like. Woulff's Bottles are particularly useful when gases have to be passed through several liquids in succession, either to wash and purify the gases, or to prepare solutions of them.

GAS-LEADING TUBES.

1940. GLASS TUBES, suitable for Gas-leading Tubes, in lengths of 3 or 4 feet, and of any desired diameter and strength, soft glass, free from lead, and easy to bend, per lb., 1s. 4d. See particulars at page 21.

1941. BENT TUBES FOR GAS BOTTLES. The following figures comprehend the form in most frequent use:—



1941.

- a.* Connector, with wide tube, to receive water rising with gas from a gas bottle. Wide tube, 6-inch by $\frac{5}{8}$ inch; narrow tube, 11 inches by $\frac{1}{3}$ inch, 8d.
- b.* Connector, with one bulb and bent tube, 14 inches by $\frac{3}{8}$ inch, 4d.
- c.* Connector, long branch, 16 inches by $\frac{3}{8}$ inch, 8d.
- d.* Bulb tube, with bent gas jet in one piece, 9d.
- e.* Connector, with one bulb, to collect water which rises with gas from a bottle, 5d.
- f.* Connector for oxygen gas tube retort, long branch, 18 inches by $\frac{5}{8}$ inch, 8d.
- g.* 7-shaped Tubes for connecting Woulff's Bottles, 5-inch, 2d.; 8-inch, 2d.; 12-inch, 3d.; 16-inch, 4d.
- h.* Connector to adapt an upright gas bottle to a U-shaped tube receiver, Fig. 2056, ground ends, 16-inch by $\frac{3}{8}$ inch, 4d.
- i.* Connector to adapt an upright gas bottle to a V-shaped tube receiver, Fig. 2057, ground ends, 16-inch by $\frac{3}{8}$ inch, 4d.
- j.* Connector to carry hydrochloric acid gas into a solution flask. The lower end should dip but slightly into the water, so that no more can be driven back than can be contained in the bulb, 1s. 3d.
- k.* Connector, with two bulbs, for receiving the water which rises with gas from a gas bottle, 6d.
- l.* Bent gas-leading tubes, Fig. 7, of a great variety of sizes and curves, in price from 2d. to 1s. each.
- m.* Connector, long branch, 7 inches by $\frac{3}{8}$ inch, 6d.
- n.* Wide Connector, for use with narrow testing tubes, as in applying sulphide of hydrogen, &c., small size, $\frac{3}{8}$ inch wide, 2d.

- n n.* Connector, larger size, $\frac{1}{2}$ inch wide, 3d.
o. Another form of Connector for sulphide of hydrogen, $\frac{1}{2}$ inch diameter, 3d.
o o. Ditto, with point ground aslant, 4d.
p. Connector, long branch, 16 inches by $\frac{3}{8}$ inch, 8d.
p p. Ditto, slight, 10 inch, 3d.

SAFETY TUBES AND ACID FUNNELS.

1942. *a.* THISTLE ACID FUNNELS, with long necks, for fitting Gas Bottles, &c., Fig. *a*, and Figs. 8, 9, 10 in the group of funnels, No. 1598, made of German glass tube, with one-inch funnel.

No. 1. Neck, 4 to 8 inches long, 2d.	No. 4. Neck, 13 to 14 inches long, $3\frac{1}{2}$ d.
2. „ 9 to 10 „ $2\frac{1}{2}$ d.	5. „ 15 to 18 „ 4d.
3. „ 11 to 12 „ 3d.	6. „ 24 „ 6d.

b. Acid Funnels, with long neck, strong tube, conical funnel.

1. Tube, 9 to 10 inches long, funnel, $1\frac{1}{2}$ inches wide, 6d.

2. „ 11 to 12 „ „ $2\frac{1}{2}$ „ 7d.

3. „ 13 to 15 „ „ 3 „ 8d.

4. „ 16 to 20 „ „ 4 „ 10d.

5. Any of these Tube funnels, bent in the neck, for putting acids into retorts (see Figs. 11, 12, group of funnels, No. 1598), at 2d. each extra.

c. 1. Safety Tube with bend, without bulb, 12 to 14 inches, 6d.

2. Ditto, larger size, about 21 inches, 8d.

d. 1. Safety Tube, with bend and one bulb, 15 inch, 6d.

2. Ditto, larger size, about 21 inches, 10d.

e. Safety Tube, with two bulbs, short form, 6d.

f. 1. Safety Tube, with two bulbs, long form, 9d.

2. Ditto, larger size, 20 inches, 1s.

g. Safety Tube, with three bulbs, long form, 1s.

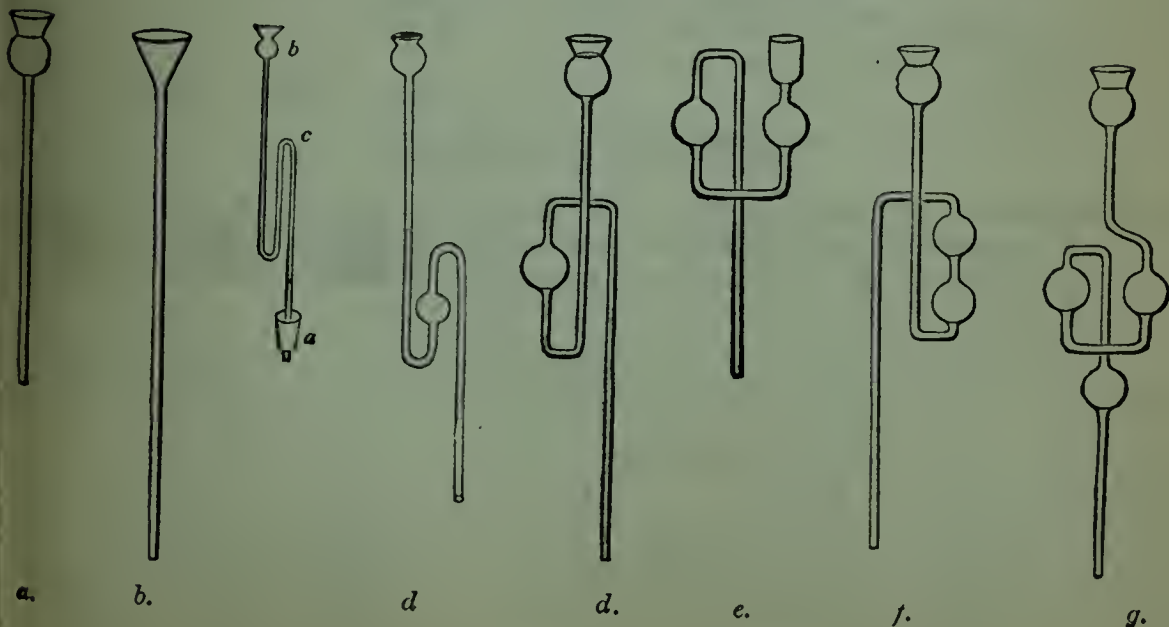
h. Safety Tube, with three bulbs, short form, 1s.

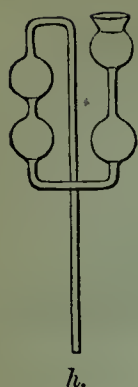
i. Safety Tube, with four bulbs, short form, 1s.

j. Safety Tube, with cylindrical funnel, 22 inches, 1s.

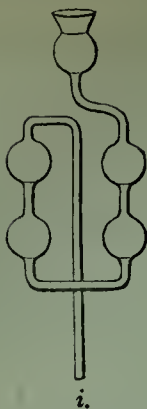
k. Safety Tube, with two ground glass valves, 1s. 6d.

l. Welter's Safety Tube, for connecting Woulff's Bottles, 1s. 3d.





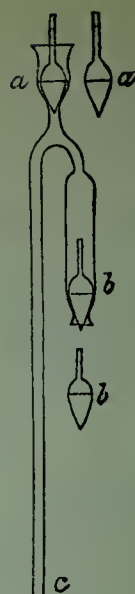
h.



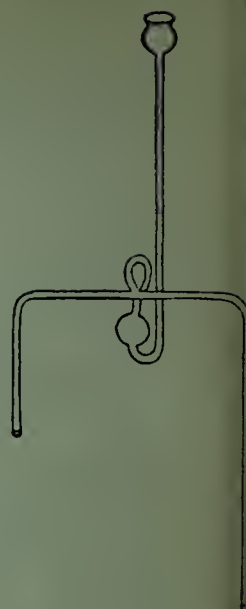
i.



j.



c.



k.

1943. Acid-dropping Funnels for Gas Bottles, strong, made at the Glass-house, with ground stopper, Fig. 1943, 1s. 3d.

1944. Ditto, with stopcock in the neck, large size, Fig. 1944, Bohemian glass, 4s.

1945. Ditto, with glass stopcocks, for regulating the supply of acid, of light glass blown before the lamp, funnels 2 inches diameter, tubes 12 inches long Fig. 1945, 2s.

1946. Acid-dropping Funnel, with stopcock, reservoir, and ground stopper, form of Fig. 1946, bulb 2 inches, tube 12 inches, 2s. 6d.

1947. Massive Retort Funnels :—

a.	Funnel 2 inch,	tube 16 inch,	8d.
b.	„ 2½ „	„ 20 „	10d.
c.	„ 3 „	„ 24 „	1s.

1948. Plain Straight Glass Tubes, for fitting into gas bottles, as acid tubes, ½ inch wide, 8 or 10 inches long, 1d. each.

1949. Plain Straight Tubes, of salt-glazed stoneware, 7 inches long, ½ inch wide, 1d. each.



1943.



1944.



1945.



1946.

CAOUTCHOUC FITTINGS.

1950. VULCANISED CAOUTCHOUC CAPS, for fitting glass tubes to gas bottles, &c., well made, stout necks; diameter of necks ¼ inch to ⅜ inch.



1950.

Width of the Cap.	With 1 Neck.	With 2 Necks.	With 3 Necks.	Width of the Cap.	With 1 Neck.	With 2 Necks.	With 3 Necks.
¾ inch	2d.	2½d.		1¾ inch	5d.	6d.	7d.
1 „	2½d.	3d.		2 „	6d.	7½d.	8½d.
1¼ „	3d.	4d.	4d.	2¼ „	7d.	8½d.	9½d.
1⅜ „	4d.	4½d.	5d.	2½ „	8d.	9½d.	10½d.
1½ „	4½d.	5½d.	6d.	3 „	10d.	12d.	13d.

1951. Caoutchouc Caps $1\frac{3}{4}$ inch wide, with two necks for $\frac{1}{2}$ inch tubes, 9d.
 1952. Caps $1\frac{1}{4}$ inch to $1\frac{3}{4}$ inch wide, with two necks, and a solid perforated stopper fixed within the Cap, 9d.
 1953. VULCANISED CAOUTCHOUC TUBES, for conveying gases, joining glass tubes, &c., made in lengths of 20 feet, but any shorter length may be had. Price per foot, according to the Internal Diameter:

$\frac{1}{8}$ inch, 2d.	$\frac{1}{4}$ inch, 6d.	$\frac{1}{2}$ inch, 1s.
$\frac{1}{8}$ „ 3d.	$\frac{5}{16}$ „ 7d.	$\frac{5}{8}$ „ 1s. 3d.
$\frac{3}{16}$ „ 5d.	$\frac{3}{8}$ „ 8d.	$\frac{3}{4}$ „ 1s. 4d.

1954. GLAZED GAS TUBES, without odour, and not liable to choke when bent, but requiring a brass connector to be cemented at each end:—

Price per Foot, according to the External Diameter.

$\frac{1}{4}$ inch, 5d.; $\frac{3}{8}$ inch, 6d.; $\frac{1}{2}$ inch, 9d.; $\frac{5}{8}$ inch, 1s.; $\frac{3}{4}$ inch, 1s. 3d.

1955. Caoutchouc Tube, with wire inside, second quality, $\frac{1}{4}$ inch bore, per foot, 6d.
 1956. Waterproof Cloth Tube, for conducting gases, $\frac{5}{8}$ inch bore, per foot, 9d.

CAOUTCHOUC STOPPERS. See No. 193.

1957. Caoutchouc (not vulcanised) in sheets, $\frac{1}{16}$ inch thick, for forming tubes, covering jars, &c.; piece of 100 square inches, 1s. 6d.
 1958. Ditto, per lb., 8s.
 1959. Caoutchouc in a liquid (pasty) state, for varnishing, waterproofing, making air-tight joints in complex apparatus, &c.; per lb., in a canister, 3s.
 1960. Ditto, small canister, 1s. 9d.

MISCELLANEOUS FITTINGS FOR GAS APPARATUS.

Corks. See No. 168.

Cork Borers. See No. 169.

Files. See No. 177.

Stopcocks of Glass. See No. 144.

Stopcocks of Brass. See No. 697.

Pinchcocks. See No. 156.

FITTED GAS BOTTLES.

1961. Gases, the production of which demands the aid of heat, must be prepared in vessels that will not spoil when heated. When they are of glass, they must therefore be thin at the bottom, otherwise they split when heated. Good German and Bohemian hard glass flasks with thin bottoms, such as are described at pages 145 to 150, answer very well.

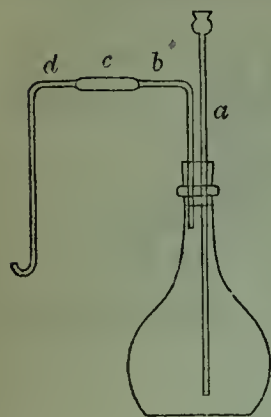
When heat is not required, it is best to choose vessels with flat strong bottoms, which do not readily break when placed on a table, nor overturn when rendered top-heavy by tall acid funnels and other necessary fittings. Bottles that serve for gases with heat serve equally well in the cold, only they are needlessly fragile. Among the gases that are made in the cold, those most frequently required are hydrogen, carbonic acid, and sulphuretted hydrogen. Among those that require heat, those most in request are oxygen, chlorine, ammonia, muriatic acid, and sulphurous acid.

Apparatus suitable for the preparation of these gases is described in the following list.

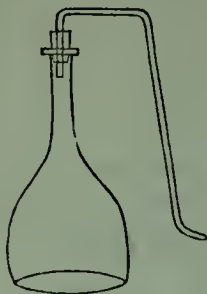
HYDROGEN GAS BOTTLES.

962. Hydrogen Gas Bottle, Hard German Glass, fitted, 30 ounce size, with long acid funnel and gas delivery tube, with flexible connector, Fig. 1962, 2s.
 963. Ditto, 16 ounce, without acid funnel, Fig. 1963, 1s.

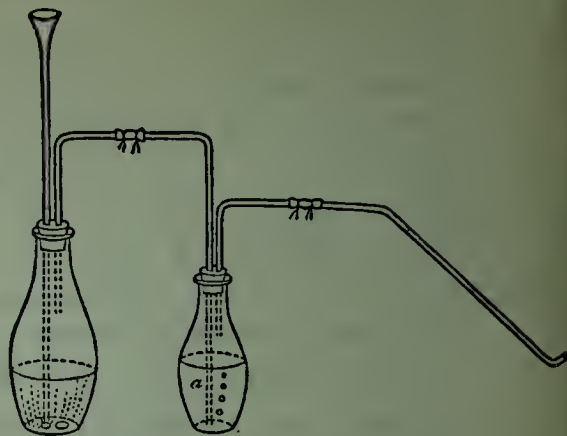
1964. Hydrogen Gas Bottles, quart size with 30 ounce washing bottle, with funnel, connecting tubes and caoutchouc caps, Fig. 1964, 4s.



1962.



1963.



1964.

1965. Fitted with caoutchouc cap and one gas-leading tube with flexible joint, Fig. 1965, $\frac{1}{2}$ pint size, 1s. 3d.

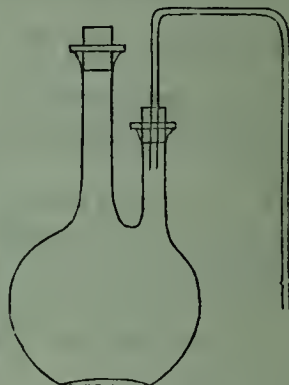
1966. Pint size, 1s. 6d.

1967. Two pint size, 1s. 9d.

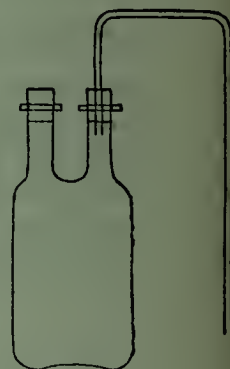
1968. Light Flask, of hard German glass, with two necks and bent tube, Fig. 1968, 1 to 2 ounce, either round or flat bottom, 6d.



1965.



1968.



1969.

1969. Woulff's Bottle, slight blown glass, 3 ounce, two necks, with cork and tube, Fig. 1969, 1s.

1970. Woulff's Bottle, 3 ounce, three necks, with tube, 1s. 3d.

1971. Gas Bottle for preparing gases, either with or without heat, with tubulure for attaching a gas-leading tube, hard white Bohemian glass, Fig. 1971.

The following sizes :—

$\frac{1}{2}$ pint,	1s. 4d.	2 pints,	2s.	4 pints,	2s. 9d.
1 „	1s. 6d.	$2\frac{1}{2}$ „	2s. 3d.	5 „	3s.
$1\frac{1}{2}$ „	1s. 8d.	3 „	2s. 6d.	6 „	3s. 3d.



1971.

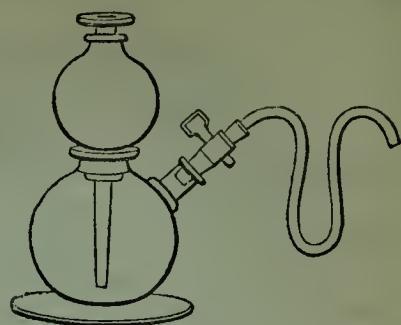
1972. The preceding Gas Bottle, with a long acid funnel adapted to the mouth by a cork, and a bent gas delivery tube attached to the side-neck by a caoutchouc cap:—

$\frac{1}{2}$ pint, 2s. 6d. | 1 pint, 2s. 9d. | $1\frac{1}{2}$ pint, 3s. | 2 pints, 3s. 6d.

1973. Vogel's Gas Bottle, with combination of acid funnel and gas delivery tube, 30 ounce flask, Fig. 2035, the parts marked *a*, A, 2s. 6d.

1974. Gas Bottle for the continuous supply of any gas that can be prepared without heat, Fig. 1974, massive cut Bohemian glass, five pieces ground together, 18s.

The lower globe is 5 inches in diameter, the funnel globe is 4 inches in diameter. They are ground together at the neck. The ground stopper is perforated, so that it can be closed by a cork that carries a bent acid funnel. The glass stopcock and the bent tube are fitted together and into the globe by grinding. If the solid materials required to produce a gas are put into the lower globe and acid into the funnel, the lower globe is speedily filled with gas, and the acid driven back into the upper globe. When gas is required it is drawn from the bent tube, the stopcock being opened. The acid then descends from the funnel into the globe, and replenishes it with gas. In the production of hydrogen gas, a zinc plate can be coiled round the neck of the funnel. The bent tube is to be filled with materials for drying or purifying the gas.



1974.

1975. Berzelius's Gas Bottle, for the preparation of hydrogen, carbonic acid, and other gases that do not require the aid of heat; the bottle of two pints capacity, with funnel for the gradual supply of acid; two sorts, namely, one with a long stopper ground into the funnel neck, Fig. 1976, the other with a glass stopcock in the funnel neck, Fig. 1975; fine white Bohemian glass, the joints well fitted by grinding.



1975.



1976.

1975. The Gas Bottle with the stopcock, 12s.

1976. The Gas Bottle with the long stopper, 8s.

1977. Gas Bottles, similar to Fig. 1975, but with the acid funnel of a conical form, and provided with a long stopper; fine white German glass, the joints well ground together:—

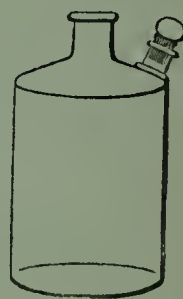
1½ pint, 5s. 6d. | 2 pints, 6s. 6d. | 3½ pints, 9s. | 7 pints, 12s.

1978. Berzelius's Gas Bottle, with acid funnel and long stopper, the bottle like Fig. 1975, the funnel like Fig. 1976, excepting that the tube is long enough to reach to the bottom of the bottle; German glass, capacity 4 to 6 ounces, 1s. 6d.

1979. Berzelius's Gas Bottle, not fitted, form of Fig. 1979, with two necks, both ground inside, one fitted with a stopper, fine white German glass:—

1 pint, 3s. | 1¼ pint, 3s. 6d. | 3½ pints, 5s.

980. MICRO-CHEMICAL GAS BOTTLES, with narrow gas delivery tubes in one piece, hard white German glass, slight, used for preparing and delivering small quantities of hydrogen or other gas with avoidance of atmospheric air.



1979.



1980. 1981.

980. Three ounce size, bulb 2 inches diameter, 6d.

981. Eight ounce size, bulb 3 inches diameter, 8d.

982. Three ounce size, bulb 2 inches diameter, 6d.

983. Three ounce size, bulb 2 inches diameter, 6d.

984. Three ounce size, bulb 2 inches diameter, 6d.

985. Three ounce size, bulb 2 inches diameter, 8d.

986. Three ounce size, bulb 2 inches diameter, 8d.



1982.



1983.



1984.



1985.

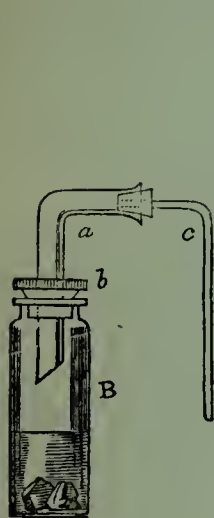


1986.

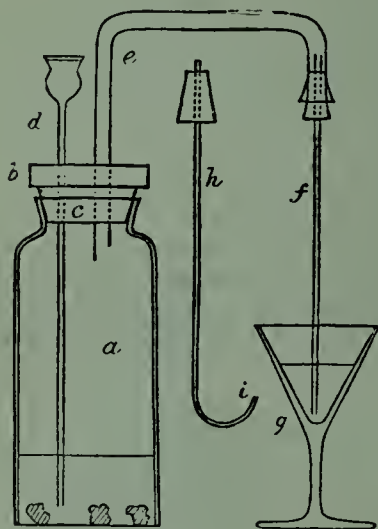
BOTTLES FOR SULPHURETTED HYDROGEN GAS.

A. WITH ONE BOTTLE, WITHOUT A WASHING BOTTLE.

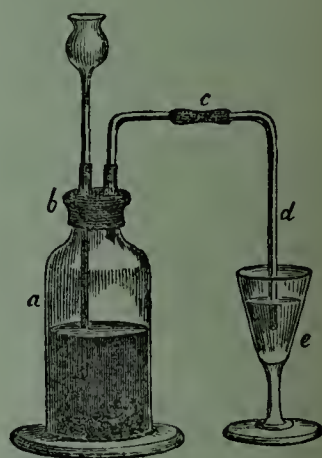
1994. Cylindrical Bottle, 5 ounce size, with wide bent tube, and narrow gas delivery tube, Fig. 1994, 1s.
1995. Cylindrical Bottle, 10 ounce size, with wide bent tube, narrow delivery tube and acid funnel, as represented in Fig. 1995, 2s.
1996. Bottle with solid glass foot, as shown by Fig. 1996, 10 ounce size, with an acid funnel and wide bent tube, fitted by a cork, and a narrow delivery tube, 2s.



1994.



1995.



1996.

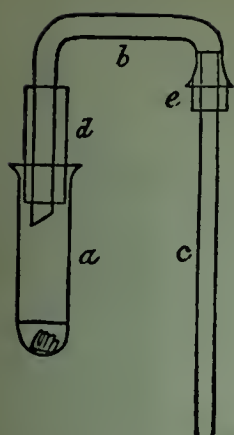
1997. Bottle with solid glass foot, 20 ounce size, fitted as shown by Fig. 1996, with caoutchouc cap, acid funnel, flexible bent tube, 2s. 6d.

The above gas bottles are all chosen with a wide neck for the convenience of inserting the lump of sulphide of iron. When the gas has been prepared, the acid should be poured off, the remaining sulphide of iron washed with water, and the bottle left partly filled with water, ready for the next operation.

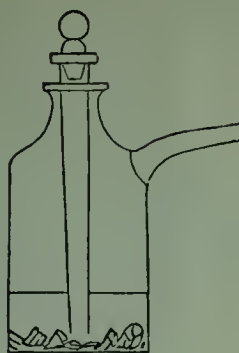
1998. Slight bulb flask, for preparing a small quantity of sulphuretted hydrogen gas, in testing for arsenic, &c., with delivery tube attached, 3 ounce size, form of Fig. 1980, 6d.
1999. Ditto, 8 ounce size, 8d.
2000. Very portable apparatus, for the same purpose, suitable for travelling sets of apparatus, made of glass tubes, Fig. 2000, 1s.
2001. Bottle for Sulphuretted Hydrogen Gas, after Berzelius, slight blown glass, fitted as shown by Fig. 2001, contents 3 to 4 ounces, 1s. 6d.

B. WITH WASHING BOTTLE, AND MOUNTED ON A WOODEN BLOCK.

2002. Sulphuretted Hydrogen Apparatus, consisting of a Woulff's Gas Bottle 20 ounce size, with 10 ounce washing bottle, 7s. 6d.
2003. Ditto, 40 ounce size, with 16 ounce washing bottle, 10s. 6d.
2004. Wide necked bottle, 40 ounce size, with 16 ounce washing bottle, on a block 5s. 6d.
2005. Sulphuretted Hydrogen Gas Bottle, with a washing bottle attached, on a wooden block (as used at the Royal College of Chemistry), Fig. 2005, 20 ounce gas bottle and 8 ounce wash bottle, 3s. 6d.



2000.



2001.



2005.

2006. KIPP'S APPARATUS for affording a constant supply of SULPHURETTED HYDROGEN Gas, consisting of three glass globes as represented by Fig. 2007.

To arrange the Apparatus for use.—Put a piece of sheet lead round the neck of the funnel at *a*, to partially close the passage into the lower globe, and prevent the sulphide of iron from running down, but not to prevent the rising of the acid; put in the sulphide of iron by the neck *d*, and the diluted acid by the upper neck. The gas gathers in the middle globe, and passes out by the stopcock at *d*.

2006. Largest size, about 6 inch globes with solid glass stopcock, ground into the neck *d*, fine Bohemian glass, with cut stoppers, 20s.

2007. Middle size, globes above 5 inches diameter, small glass stopcock, and ground stopper at top, Fig. 2007, 12s.

2008. Small size, 4 inch globes without the neck on the lowest globe, with small glass cock and ground stopper at top, 8s.

No. 2006 stands about 2 feet high; No. 2008 about 16 inches. The figure represents the style of the middle size and quality.

2009. Simple Apparatus for the Preparation of LIQUID HYDROSULPHURIC ACID, Fig. 2009, flask 6 ounce, solution bottle, stoppered, 20 ounce, 1s. 6d.

From time to time the delivery tube is withdrawn and the bottle is closed and shaken. If after shaking the bottle, you receive, on loosening the stopper, that air rises into the bottle, the water is not quite saturated with the gas. The entrance of the gas is best seen by holding the bottle in the position shown by Fig. 2010.



2009.



2010.



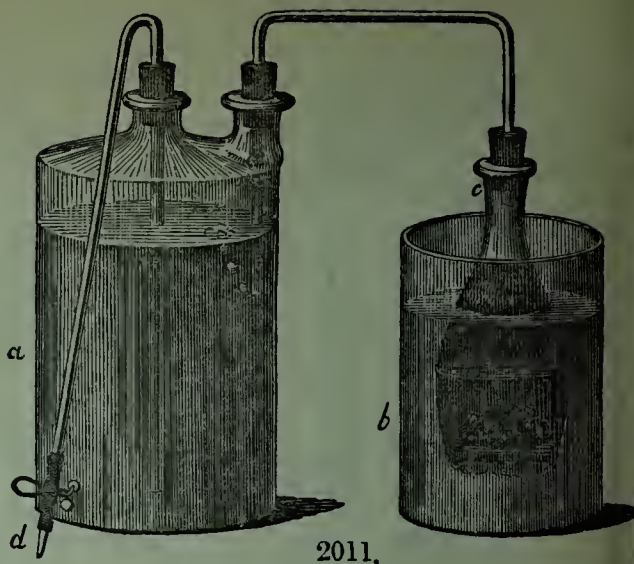
2007.

2011. MOHR'S APPARATUS for the constant supply of Liquid Hydro-sulphuric Acid (*Solution of sulphuretted hydrogen gas in water*).

2011. Pint size, complete, as represented in the Figure, 5s.

2012. Quart size, complete, 6s.

The jar *b* is to contain the diluted sulphuric acid, and the flask *c*, the sulphide of iron used for producing the gas. The bottle *a* contains the water that is to absorb the gas, and the solution when prepared, is to be drawn off by the jet on the syphon *d*. See "Chemical Recreations," page 621.



OXYGEN GAS BOTTLES.

2014. Oxygen Gas Tube Retort, for preparing oxygen gas by the distillation of chlorate of potash with peroxide of manganese Fig. 2014, consisting of a stout hard Bohemian glass tube, 6 inches long, 1 inch wide, with long delivery tube, $\frac{1}{2}$ inch wide, 1s.

2015. Similar apparatus in which the distilling tube is made of copper, hard soldered, size, 6 inches by $1\frac{1}{2}$ inches, with metal delivery tube, 3s. 6d.

2016. Bohemian hard glass Retort, Fig. 1935, about 20 ounce size, fitted with glass delivery tube, 2s.

2017. Retort of the most infusible white Bohemian glass, very stout, for preparing oxygen and other gases that require the application of a high temperature, 5 ounce size, 1s.

2018. Ditto, 10 ounce size, 1s. 6d.

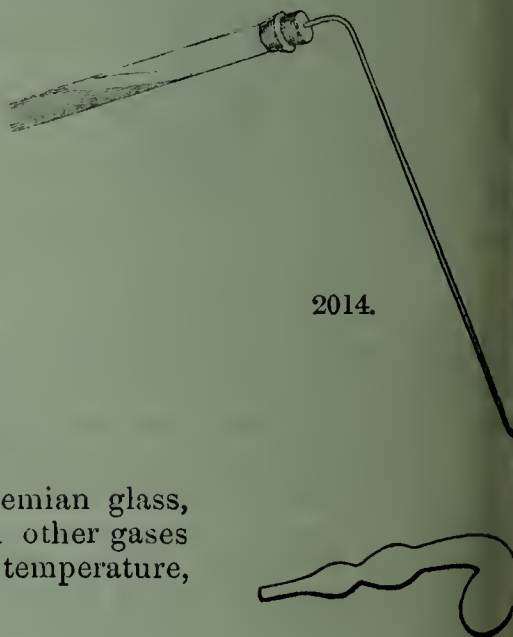
2019. The same retort when fitted with a gas-leading tube, 5 ounce size, 2s.

2020. Ditto, 10 ounce size, 2s. 6d.

2021. Flask of strong hard German glass, globular form, with wide neck. Similar to Fig. 1410, but fitted with caoutchouc cap and gas delivery tube.

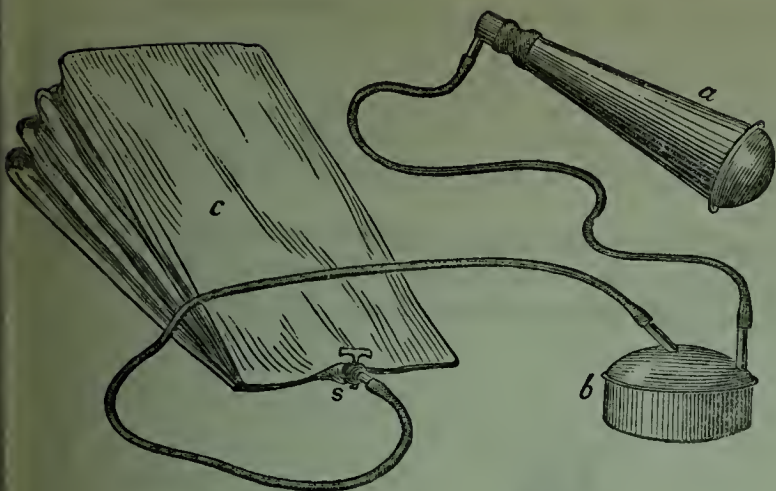
10 ounce, 1s. 9d. | 20 ounce, 2s. | 35 ounce, 2s. 6d.

2022. Oxygen Retort, made of sheet iron, with copper bottom, for preparing the gas in quantities of 5 or 6 cubic feet, for the magic lantern, &c., by heating chlorate of potash with manganese, with 3 feet of caoutchouc tube, *a*, Fig. 2022, 9s.

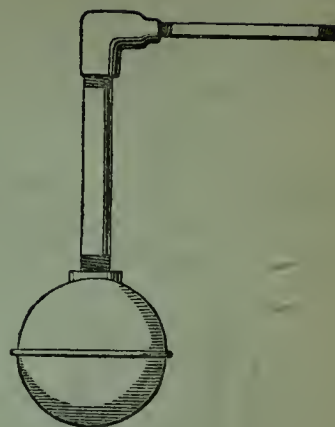


For Prices of Gas Bags similar to *c*, Fig. 2022, see No. 2149.

2025. Oxygen Retort, consisting of a 5 inch copper globe with iron neck, and long gas delivery tube, Fig. 2025, a strong and durable apparatus, 12s. 6d.



2022



2025.

026. Oxygen Retort, cast iron, for preparing oxygen gas by igniting peroxide of manganese, $6\frac{1}{2}$ by 4 inches, containing $1\frac{1}{2}$ pints, with long metal delivery tube, 7s.

027. Ditto, $11\frac{1}{2}$ inches by 5 inches, containing 5 pints, 8s.

CHLORINE GAS BOTTLES.

033. Bottle for preparing gases that require heat, such as chlorine, 16 ounce size, with long gas delivery tube, Fig. 2033, 1s.

034. Mohr's Bottle for the preparing of chlorine gas by an improved process, see "Chemical Recreations," page 663, a 40 ounce flask, with safety funnel and gas delivery tube, Fig. 2034, 3s.

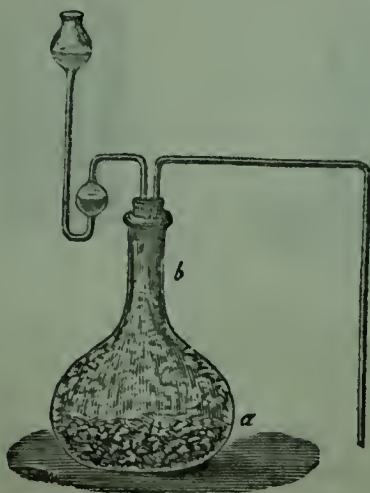
Apparatus for preparing chlorine gas in the large way has been described at p. 1918.

Wash Bottles for Gases.

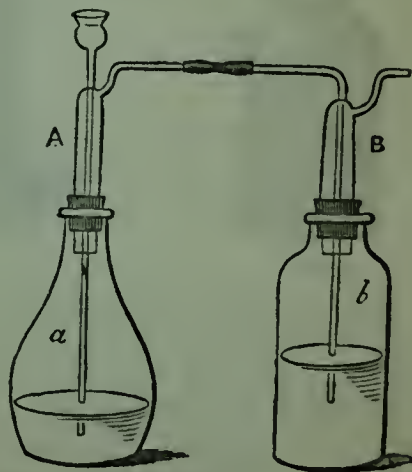
35. Vogel's Modification of Woulff's Apparatus, consisting of two 30 ounce one-necked flasks, one serving as a gas bottle, and the other as a wash bottle, connected by tubes so constructed as to make each bottle with one neck serve the usual office of a bottle with two necks, Fig. 2035, the pair, 5s.



2033.



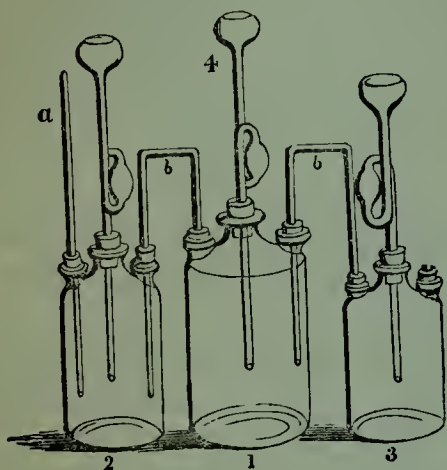
2034.



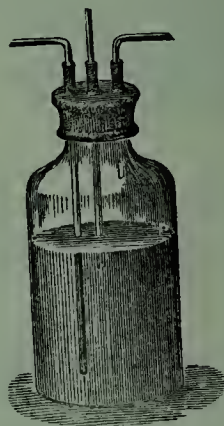
2035.

The Funnels of the Apparatus, No. 2035, separately as follows:—

2036. Vogel's Acid Funnel, A, Fig. 2035, 1s. 3d.
 2037. Vogel's Gas Leading Tube, B, Fig. 2035, 1s. 3d.
 2038. Sets of Woulff's Apparatus, of any number of bottles or any size of bottles fitted up to order, either in the style of Fig. 2038, or arranged in mahogany trays.
 2039. Sets of Woulff's Apparatus, prepared with wide mouthed bottles and caoutchouc caps, either with two necks or three necks, as represented by Figs. 2039 and 2040. These caps are supplied separately; see No. 1950.



2038.



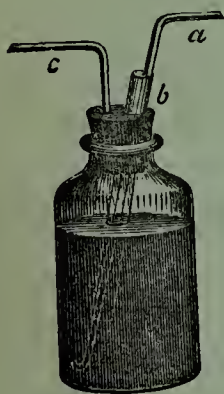
2039.



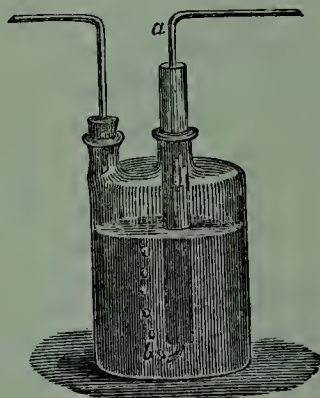
2040.

2041. Woulff's Bottles, fitted with wide tubes, which permit the gas delivery tube to be readily withdrawn, and the solutions to be shaken to facilitate the absorption of the gas.

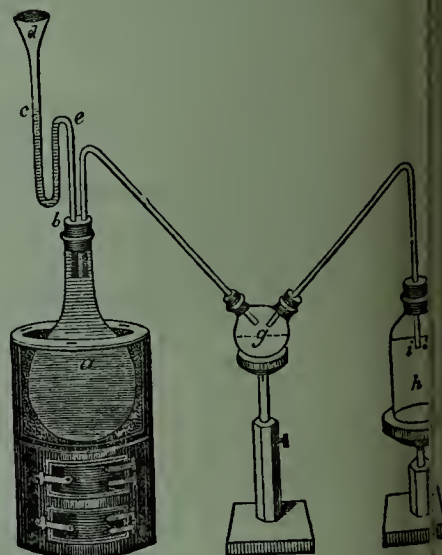
Fig. 2041.	20 ounce bottle,	1s. 3d.
"	30 "	1s. 6d.
Fig. 2042.	20 "	2s. 3d.
"	30 "	2s. 9d.



2041.



2042.



2045.

2045. INTERMEDIATE RECEIVERS, with two necks, through which gases are passed in the way between gas bottles and receivers, in order to deposit any acid or water which they may carry mechanically, see *g*, Fig. 2045, and *b*, Fig. 1938.

See list of prices at No. 1849.

The apparatus represented by Fig. 2045 is for the preparation of Liquid Hydrochloric Acid. The acid gas is prepared in the flask *a*, and the water to absorb it is placed in the bottle *h*. Another form of gas-leading tube, for use instead of the form *i*, is shown by *j*, Fig. 1941.

2046. APPARATUS FOR WASHING GASES, suitable for use when a large quantity of thoroughly washed gas is required, consisting of a circular glass cistern, 7 inches deep, and 12 inches diameter, mounted on a wooden base, with a system of five concentric brass cylinders, which dip into the water, and force the gas to take a long passage through it, 60s.

Apparatus for Drying Gases.

2047. When gases issue from flasks in which they are prepared with the assistance of aqueous acids, they are necessarily saturated with water in the state of vapour. If they are required to be in a dry state it is usual to pass them through vessels that contain substances that strongly absorb water, such as dried or fused chloride of calcium, broken into small lumps, or fragments of pumice stone, or filaments of asbestos, that have been saturated with oil of vitriol. The vessel to contain these desiccating substances must be chosen, as to form and size, in accordance with the particular plan of each experiment. If the quantity of gas is small and the weight of the absorbed water is to be ascertained—a process of great importance in organic analysis—the chloride of calcium is put into a very small and light glass tube capable of being weighed on a delicate balance. If on the other hand, a large quantity of gas is to be dried, and no account is to be taken of the abstracted water, then the drying substance is used in a greater quantity and in a more bulky vessel. Various forms of apparatus suitable for these purposes are represented by the following Figures :

CHLORIDE OF CALCIUM TUBES FOR DRYING GASES.

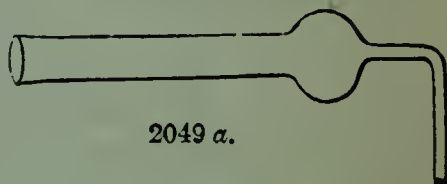
A, consisting of a wide tube and a narrow tube, having a bulb between them.

2048. *With straight neck, form of Fig. 2048.*

- a. Tube $3\frac{1}{2}$ by $\frac{3}{8}$ inch, 1 bulb, neck 2 by $\frac{1}{2}$ inch, 2d.
- b. Tube 5 by $\frac{1}{2}$ inch, 1 bulb, neck 2 by $\frac{1}{2}$ inch, 3d.
- c. Tube 8 by $\frac{1}{2}$ inch, 1 bulb, neck 3 by $\frac{1}{4}$ inch, 4d.
- d. Tube 5 by $\frac{7}{8}$ inch, 1 bulb, neck 3 by $\frac{3}{8}$ inch, 8d.
- e. Tube 7 by $\frac{7}{8}$ inch, 1 bulb, neck 3 by $\frac{3}{8}$ inch, 9d.
- f. Tube 8 by 1 inch, 1 bulb, neck 3 by $\frac{1}{4}$ inch, 9d.



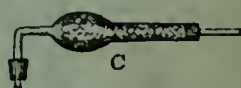
2048.



2049 a.

2049. *With bent neck, form of Fig. 2049, a and b.*

- a. Tube 6 by $\frac{1}{2}$ inch, 1 bulb, neck 4 by $\frac{1}{4}$ inch, 6d.
- b. Tube 5 by 1 inch, 1 bulb, neck 4 by $\frac{3}{8}$ inch, 8d.
- c. Tube 8 by 1 inch, 1 bulb, neck 5 by $\frac{1}{2}$ inch, 9d.
- d. Tube 8 by $\frac{1}{2}$ inch, 1 bulb, neck 5 by $\frac{1}{4}$ inch, 8d.



2049 b.

B, Chloride of Calcium Tubes, consisting of a wide tube and a narrow tube, with two bulbs between them.

2050. *With straight neck, form of Fig. 2050.*

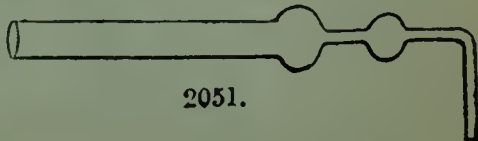
- a. Tube, 5 by $\frac{1}{2}$ inch, 2 bulbs, neck 3 by $\frac{1}{2}$ inch, 2d.
- b. Tube 7 by $\frac{1}{2}$ inch, 2 bulbs, neck 5 by $\frac{1}{4}$ inch, 8d.
- c. Tube 11 by $\frac{1}{2}$ inch, 2 bulbs, neck 6 by $\frac{3}{8}$ inch, 9d.



2050.

2051. *With bent neck, Fig. 2051.*

- a. Tube 5 by $\frac{1}{2}$ inch, 2 bulbs, neck 5 by $\frac{1}{4}$ inch, 6d.

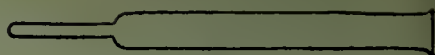


2051.

CHLORIDE OF CALCIUM TUBES, *continued*—

2052. C, consisting of a wide tube joined to a narrow tube without bulb, Fig. 2052.

Tube 9 by $\frac{5}{8}$ inch, no bulb, neck 2 by $\frac{1}{4}$ inch, 4d.



2052.

2053. D, consisting of a Cylindrical Tube, with a cork and short narrow tube at each end, letter *c*, Fig. 1938.

a. Large Tube 9 inches long, $\frac{3}{4}$ inch wide, 10d.

b. Large Tube 12 inches long, 1 inch wide, 1s.

2054. E, consisting of a U-shaped tube of uniform bore and parallel branches, form of *c*, *d*, *e*, Fig. 2054.

a. 6 inches by $\frac{1}{2}$ inch, 9d.

b. 6 „ $\frac{5}{8}$ „ 1s.

c. 8 „ $\frac{3}{4}$ „ 1s. 3d.

d. 9 inches by $\frac{1}{2}$ inch, 1s. 3d.

e. 9 „ $\frac{5}{8}$ „ 1s. 6d.

f. 12 „ 1 „ 2s.

Fig. 2054 represents Regnault's Apparatus for producing water by passing pure dry hydrogen gas over ignited oxide of copper. The apparatus and experiment are described in detail in "Chemical Recreations," at page 220.

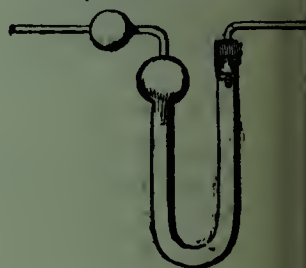
2055. F, Marchand's Form of Tube, consisting of a U-shaped tube with 2 bulbs, and connecting tubes, form of Fig. 2055, 1s.

2056. G, U-shaped Tube, not fitted, form of Fig. 2056 ; branches not parallel.

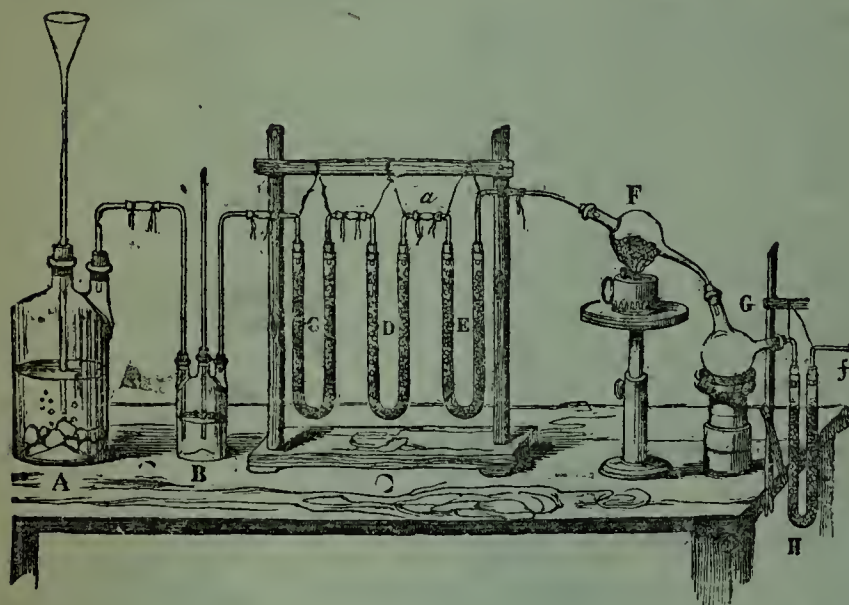
a. Large size, 21 inches long, 1 inch wide, 1s. 3d.

b. Medium size, 18 inches long, $\frac{3}{4}$ inch wide, 1s.

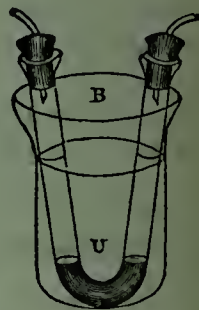
c. Small size, 12 inches long, $\frac{1}{2}$ inch wide, 9d.



2055.



2054,



2056.

2057. H, V-shaped Tube, not fitted, form of Fig. 2057.

a. Large size, 12 inches long, $\frac{3}{4}$ inch wide, 9d.

b. Small size, 9 inches long, $\frac{5}{8}$ inch wide, 6d.

c. V-shaped, with unequal legs, (*b*, Fig. 1936), 10 inches by $\frac{3}{4}$ inch, 6d.



2057.

For connectors to fit the Tubes, Nos. 2056 and 2057, to gas bottles, see *h* and *i* in Fig. 1941.

2058. I, Cylindrical Jar on foot, with a tubulure at the side near the bottom, form of Fig. 2058.

a. Size, 8 inches high, $1\frac{1}{2}$ inch wide, 2s. 6d.

b. Size, 12 inches high, 2 inches wide, 3s. 6d.

c. Size, 6 inches high, $\frac{5}{8}$ inch wide, slight glass, 1s.

2059. K, Woulff's Bottle, with tubulure at the bottom, Fig. 2059, suitable for a large quantity of desiccating material.

a. 10 ounce size, 1s.

b. 15 " 1s. 3d.

c. 20 " 1s. 6d.

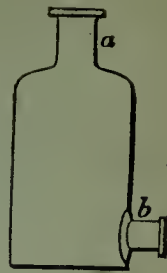
d. 25 ounce size, 1s. 9d.

e. 30 " 2s.

f. 35 " 2s. 3d.



2058.

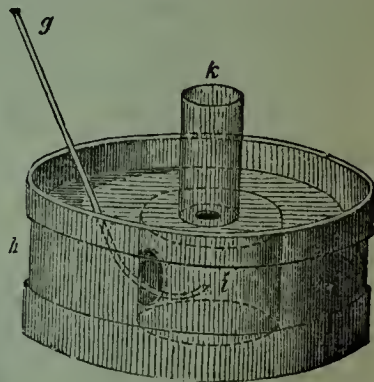


2059.

PNEUMATIC TROUGHS.

I.—GRIFFIN'S INCORRODIBLE STONEWARE PNEUMATIC TROUGHS.

2065. These consist of stoneware pans, in which are placed moveable shelves, so formed as to collect the gases and convey them into the vessels placed to receive them. Figs. 2066 and 2070 represent two varieties of the trough, and Figs. 2071 and 2072 two varieties of the moveable shelf, which are again represented as they appear when in use in Figs. 2066 and 2070. In consequence of the dome form of the interior of the shelf, it has received the name of the *beehive shelf*. As this piece of apparatus sinks in water, it is evident, that a pan, trough, or tub of any form or material can be used as a pneumatic trough with the assistance of the beehive shelf. In France, they use an instrument of a beehive form to collect gases, but they make the mistake of giving a spherical form to its outside as well as its inside, the consequence of which is, that glass jars cannot rest steadily upon the shelf. The flat-topped shelf represented in Fig. 2066 was first described in my work on *Chemical Manipulation*, published in 1838.



2066.

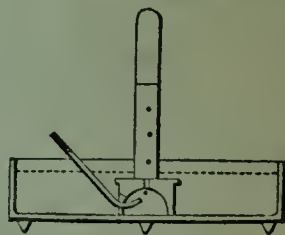
2066. Stoneware Pneumatic Trough, Fig. 2066, the trough circular, 11 inches wide, and 5 inches deep; the beehive shelf, 4 inches wide, 2s. 8d.

2067. The Trough without the beehive shelf, 2s.

2068. Stoneware Pneumatic Trough, same form as Fig. 2066, but larger; the trough, 15 inches wide and 8 inches deep; the shelf, 7 inches wide, 7s.

2069. The Trough without the beehive shelf, 5s. 6d.

2070. Flat Pneumatic Trough for experiments with Tubes, form of Fig. 2070, the trough 12 inches wide, and 2 inches deep, made of saltglazed stoneware; the shelf, form of Fig. 2072, 2 inches wide and 1 inch deep, of white porcelain, 2s. 4d.



2070.

The porcelain and stoneware mercury troughs, Nos. 2085 to 2089, can also be used with water for experiments with tubes.

2071. BEEHIVE SHELVES, with which any pan, tub, or trough can be used as a Pneumatic Trough, form of Fig. 2071.

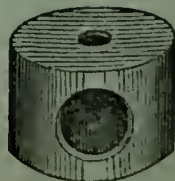
a. 4 inches diameter, saltglazed stoneware, 8d.

b. 4 inches diameter, Wedgwood's Porcelain, 1s.

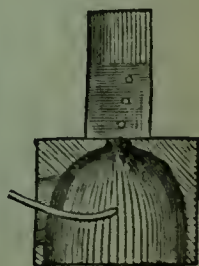
c. 5 inches diameter, saltglazed stoneware, 1s.

d. 6 inches diameter, saltglazed stoneware, 1s. 3d.

e. 7 inches diameter, saltglazed stoneware, 1s. 6d.



2071.



2072. Beehive Shelf, of the form of Fig. 2072, 2 inches wide, 1 inch deep, of stoneware, white Berlin or Wedgwood's Porcelain, 4d.



2072.

II.—METALLIC TROUGHS FOR USE WITH WATER.

2073. Pneumatic Trough of Japanned Tinplate, with moveable shelf, form of Fig. 2073; *d*, the moveable shelf. The following four sizes are kept in stock—other sizes can be made to order.

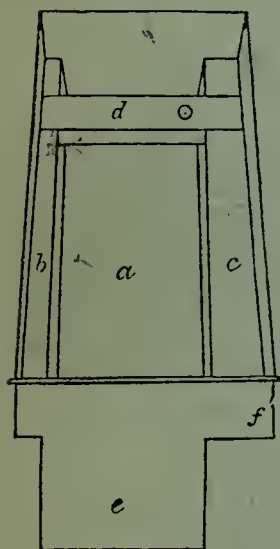
2073. 10 inch by $6\frac{1}{2}$ inch. 3s.

2075. 19 inch by $12\frac{1}{2}$ inch, 8s.

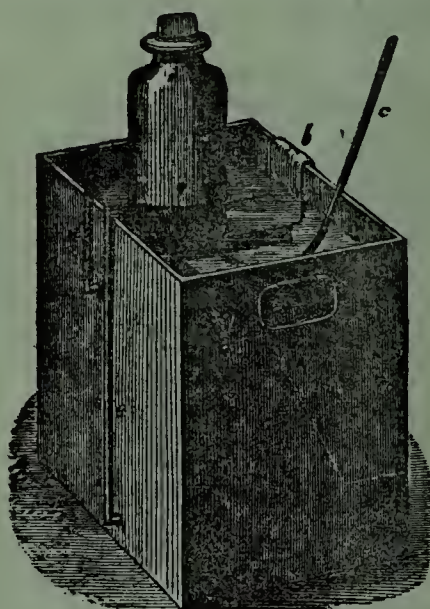
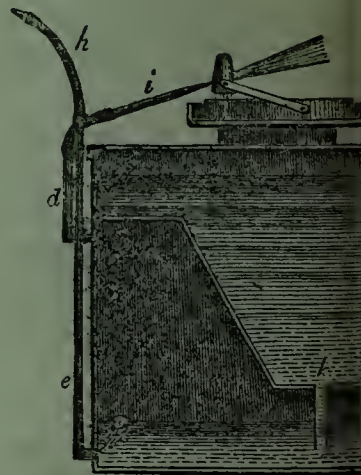
2074. 14 „ $9\frac{1}{2}$ „ 6s.

2076. $21\frac{1}{2}$ „ $15\frac{1}{2}$ „ 10s. 6d.

2077. Tate's Pneumatic Trough combined with a Hydraulic Blowpipe, for use in glass-blowing; the trough, 16 inches by 12 inches, with a moveable shelf and a cover, japanned tin plate. In Fig. 2077*a*, it is represented as seen in use as a pneumatic trough; in Fig. 2077*b*, as a hydraulic blowpipe, japanned tin plate, 16s. 6d.

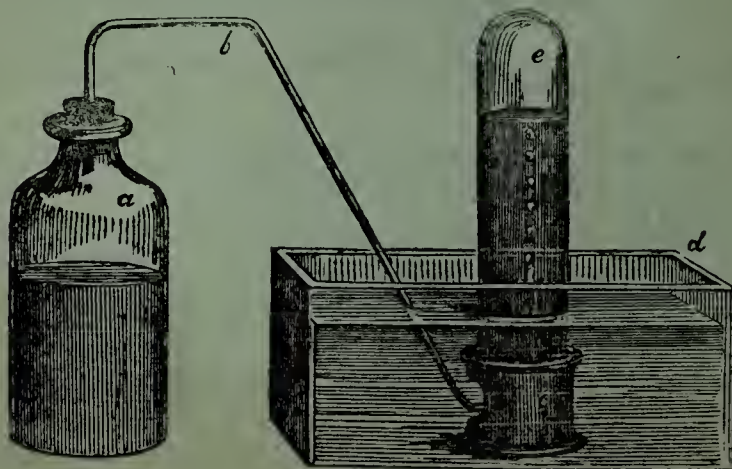


2073.

2077*a*.2077*b*.

III.—GLASS PNEUMATIC TROUGHS.

2078. Pneumatic Trough of fine white solid Bohemian glass, rectangular form, cast one piece, the edges and entire surface cut and polished, may be used either with a 4 inch beehive shelf, as shown in *d*, Fig. 2078, or with a brass sliding shelf, like that represented in Fig. 2083.



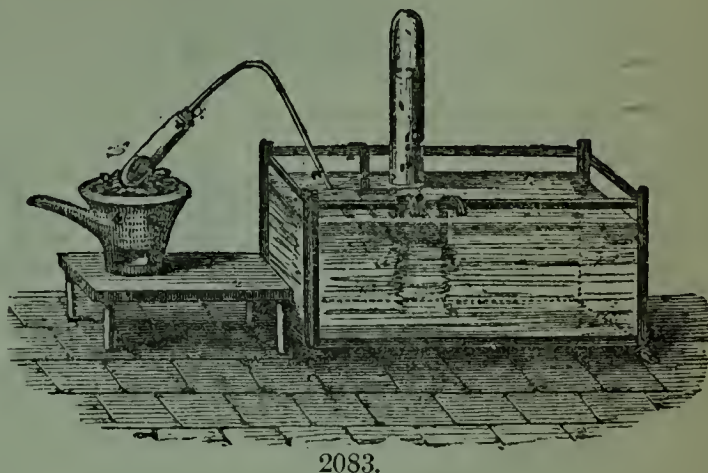
2078.

Price of the Glass Trough with a 4 inch white Porcelain beehive shelf:—

2079. The Trough 12 inches long, 6 inches wide, and 5 inches deep, 28s. 6d.
 2080. The Trough 14½ inches long, 7½ inches wide, and 5 to 6 inches deep, 33s.
 2081. The Trough 17 inches long, 8½ inches wide, and 7 inches deep, 46s.
 2082. If a brass sliding shelf is desired, the extra cost will be 4s. 6d. if in addition to the Porcelain shelf, or 3s. 6d. if without the Porcelain shelf.

When a jar of greater width than 4 inches is to be filled with gas, the 4 inch beehive shelf may be covered with a sufficiently wide perforated glass plate, Fig. 1679.

2083. Pneumatic Trough for use with water, made of stout plate glass, connected with massive brass framing and a metal bottom, with a sliding brass shelf for supporting gas jars, Fig. 2083; size, 14 inches long, 8½ inches wide, and 8 inches deep, 55s.



GLASS PNEUMATIC TROUGHS OF A CIRCULAR FORM.

2084. The Conical Pans described at page 160, under the head of "Solution," and the Cylindrical Basins described at No. 1780, under the head of "Evaporation," can be used as Pneumatic Troughs, when supplied with a Beehive Shelf, No. 2071 or 2072. It is only necessary to select a vessel that is long enough and deep enough to permit the gas receiver that is to be filled to lie flat in it, and to be turned up conveniently when full of water. The Beehive Shelf must, of course, be as wide as the gas receiver that it is intended to support. In case of need, a small Beehive Shelf may be widened by having a perforated glass plate, No. 1679, placed on the top of it.

IV. PNEUMATIC TROUGHS FOR USE WITH MERCURY.

In describing the troughs for use with mercury, the length and width inside are stated, and the quantity of mercury, in avoirdupois pounds, that is required to fill each of them; first, to a quarter of an inch above the level of the shelf, and secondly, close up to the brim. These particulars will enable the reader to form a judgment as to the sizes of glass vessels proper for use with each trough, and the quantity of mercury necessary for convenient manipulation with it.

2085. GRIFFIN'S PNEUMATIC TROUGH, FOR EXPERIMENTS WITH TUBES.

2085. In saltglazed stoneware, 1s. 3d.

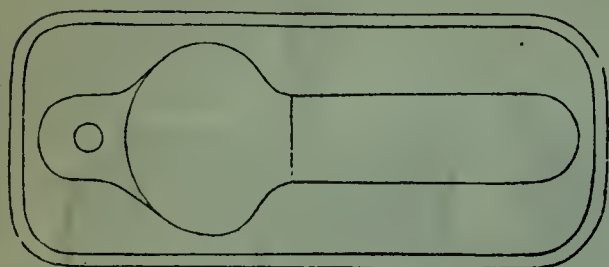
2086. In Berlin, Thuringian, or Wedgwood porcelain, white glazed, 1s. 9d.

This trough is represented by *d* in Fig. 2085. It is shown in section by Fig. 2088. It is 8 inches long inside, and it works with tubes of 6 inches long and 1 inch wide. It requires 4 lb. to 5 lb. of mercury to fill it.



2085.

2087. Griffin's Mercury Trough for Tubes, of the same internal form as the above, but rather longer and made with a border which rises above it and prevents the overflow of the mercury; it is 9 inches long and a little above 1 inch wide inside, and takes in tubes of nearly 7 inches long, by 1 inch wide. It requires about 4 lbs. of mercury to fill it over the shelf, and 8 lbs. to fill it entirely. It is represented by Figs. 2087 and 2088, in horizontal and vertical sections. In one piece, saltglazed stoneware, 2s. 6d.



2087.



2088.

2089. Pneumatic Trough, for Experiments with Tubes, Berlin pattern.

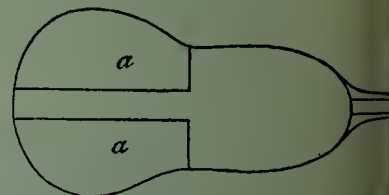
2089. In saltglazed stoneware, 2s. 6d.

2090. In Wedgwood's porcelain, 3s.

2091. In Thuringian Porcelain 4s.

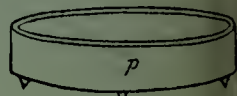
2092. In Berlin porcelain, 7s.

This trough is shown by Fig. 2089 in horizontal and vertical section. Extreme length 7 inches; extreme breadth, 4 inches, inside measurement. It requires 9 or 10 lbs. of mercury to fill it to the shelf and 18 lbs. to fill it entirely. This pattern of trough is used by Liebig, in the determination of Nitrogen in Organic Analysis.



2089.

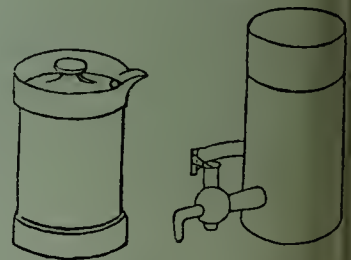
2093. Flat Pan, for use with small Mercury Troughs, to catch the overflowing mercury, saltglazed stoneware, 12 inches diameter, 2 inches deep, Fig. 2093, 2s.



2093.

2094. Mercury Pot, with spout, for pouring mercury into tubes, &c. Berlin porcelain, Fig. 2094, pint size, —namely, it holds sufficient mercury to work the small troughs, Nos. 2085 and 2087, 2s.

This porcelain bottle is too wide and too heavy to be grasped by the right hand, and effectively managed when full of mercury. A strongly stoppered glass bottle, not too wide nor too heavy to be managed with one hand, is in general more convenient.



2094.

2095.

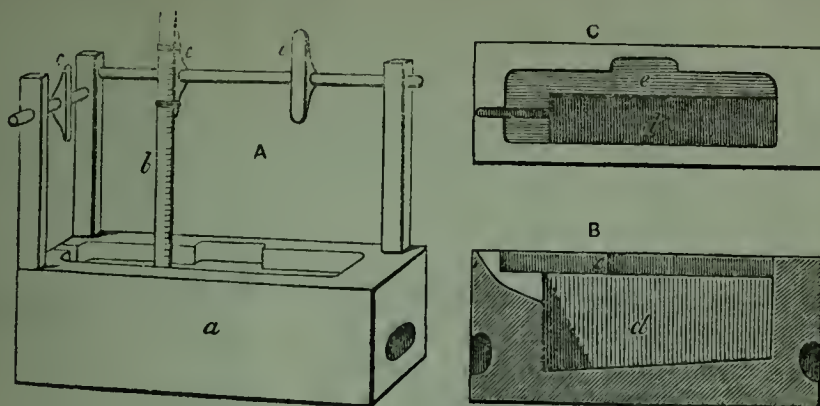
2095. Mercury Box, with steel cock and regulating spring; for pouring mercury into very narrow tubes, &c., Fig. 2095, 6s.

PNEUMATIC TROUGHS FOR MERCURY, OF LARGER SIZE :—

2096. Liveing's Pneumatic Trough, for use with mercury, Fig. 2096, 36s.

This trough is cut from a solid block of mahogany. It is represented by A in perspective, by B in longitudinal section, and by C in horizontal section. The three square upright rods are screwed into the body of the trough *a*. Into the middlemost of these uprights the round horizontal bars are screwed. The three grooved pieces *c*, *c*, *c*, made of different widths, slide freely on these bars. The gas tube *b* is fastened to one of them by caoutchouc bands. *d* shows the form of the interior of the

trough, and *e* the shelf. At each end cavities are cut in the solid to admit the fingers when the trough requires to be lifted. Dimensions of the cavity *d*, 12 inches long, $1\frac{1}{2}$ inch wide; of the cavity level with the shelf, 14 inches long, $2\frac{1}{4}$ inches wide. Quantity of mercury required to cover the shelf, 30 lbs.; to fill the trough entirely, 40 lbs. The body of the trough is in one piece, so that leakage is impossible. The fittings unscrew for packing. The mahogany is French polished.

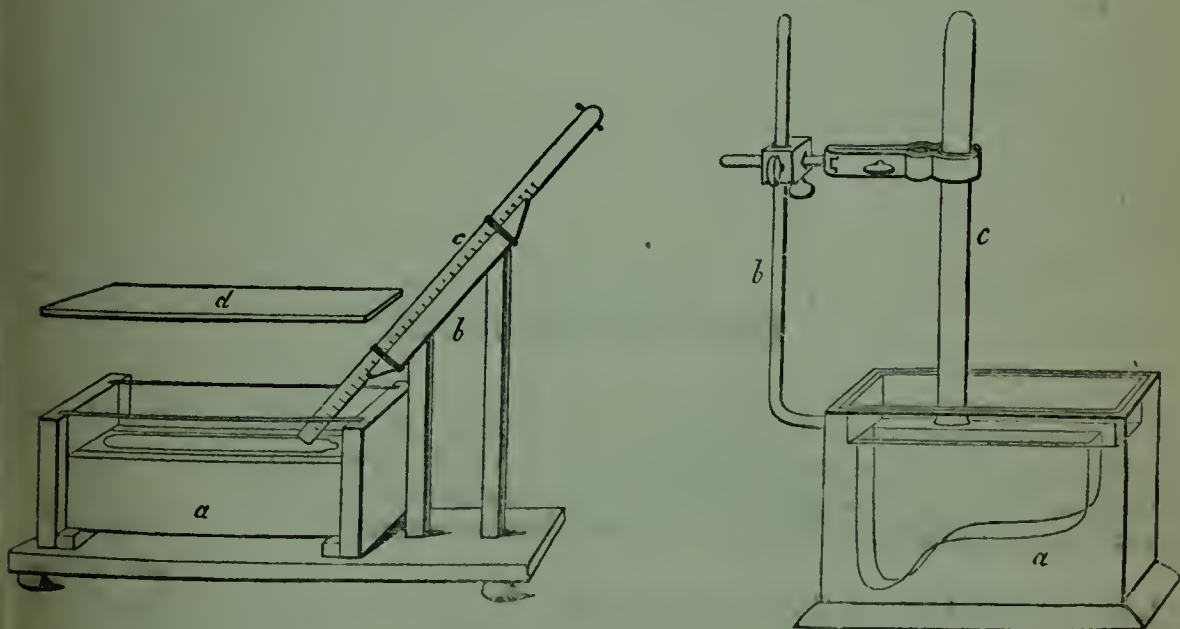


2096.

2097. Bunsen's Pneumatic Trough, for use with mercury, in the analysis of gases by eudiometrical operations, Fig. 2097, 30s.

This trough consists of a solid block of polished mahogany, with plate glass sides, and a mahogany base and frame for supporting eudiometers. Fig. 2097, *a*, represents the trough; *b*, the support for the eudiometers; *c*, an eudiometer fixed in position; *d*, a plate of glass to cover the trough when not in use, to keep the mercury clean. Interior dimensions of the upper part of the trough 14 inches long and 3 inches wide; measurement of the sunk cavity 11 inches long, $2\frac{1}{2}$ inches wide. It requires 20 lb. of mercury to cover the shelf, and 45 lb. to fill it entirely. The mahogany is French polished, and the edges of the plate glass are ground.

2098. Regnault's Pneumatic Trough, for use with mercury, Fig. 2098, without the tube marked *c*, but with the tube clamp, 36s.



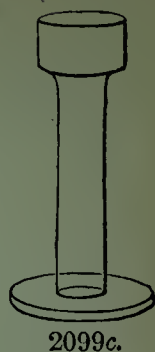
2097.

2098.

This trough consists of a solid block of cast iron, which is enclosed in a stout mahogany case. The dotted lines show the form of the cavity and of the shelf. The rod *b* is screwed through the mahogany into the iron trough. By means of the block and the sliding iron vice, Tubes, such as are represented by *c*, can be held over any part of the trough, and at any required height. Length of the cavity, $8\frac{1}{2}$ inches; breadth, $2\frac{1}{4}$ inches. Length of the cavity above the shelf, $10\frac{1}{4}$ inches; breadth, 5 inches. Quantity of mercury required to cover the shelf, 48 lb.; to fill the trough entirely, 80 lb.

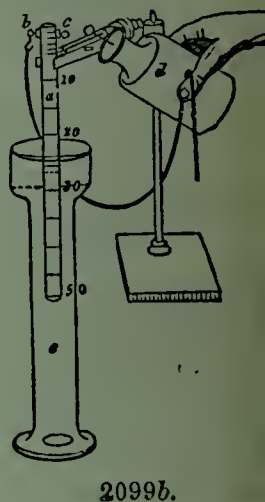
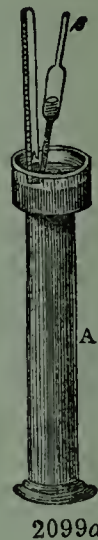
2099. Vertical Pneumatic Troughs, for use in tube operations on gases, consisting of glass jars with broad feet and expanded mouths. Fig. 2099.

No. 1.	8 inches high,	2 inches wide,	mouth 3 inches,	1s. 3d.
2. 12	"	2	"	1s. 6d.
3. 16	"	2½	"	2s.
4. 18	"	2½	"	3s.
5. 12	"	2½	"	2s. 6d.
6. 9	"	1½	"	1s. 6d.
7. 13	"	1½	"	1s. 9d.
8. 9	"	1½	"	2s.
9. 12	"	2½	"	2s. 6d.



2100. Ettling's Gas Pipette, for taking gases from jars in such troughs, small size, 1s. 3d.; large size, 1s. 6d. See also Doyere's Pipette in the Section on "Apparatus for Analysis of Gases."

Fig. 2099 c, represents the vertical trough with a broad mouth and broad foot, the latter intended to prevent the overturning of the apparatus when filled with mercury. Fig. a represents the trough as in use, when a liquid test, such as potash, is being passed up into a gas to absorb carbonic acid. Fig. b represents the mode of applying an electric spark to inflame mixtures of oxygen and hydrogen gas.



GAS RECEIVERS.

The CUBIC INCHES quoted throughout this section, as representing the CAPACITY of Glass Tubes, and of other glass vessels, are not to be considered as correct measurements, but only as numbers that approximately indicate the sizes of the respective vessels.

DEFLAGRATING JARS, or Gas Receivers, open at bottom, weltd and ground, with wide mouth, closed by a ground glass stopper, Fig. 2101, hard German glass.

2101.	5 in. high,	3 in. diameter;	Contents, about	35 cubic in.	1s.
2102.	7	"	"	90	" 2s.
2103.	9	"	"	180	" 3s.
2104.	11	"	"	300	" 4s.



2105. Deflagrating Jar, mounted with cap and gas-delivery tube, having a flexible joint secured by a pinchcock; used to collect a quantity of gas, and then deliver it into small tubes or other vessels as required; size of jar, 11 by 6 inches, 6s. 6d.

2106. TRAYS FOR HOLDING GAS RECEIVERS when filled with gas and removed from the Pneumatic Trough. (See page 15.)

2107. BELL GAS RECEIVERS, welted and ground on the edge, narrow mouths, fine white Bohemian glass, with ground stoppers, generally cut ornamentally.

The following measurements are only approximate:—



2107.



2105.

No.	Height to Shoulder.	Diam.	Capacity.	Price.
1.	5 in.	2 in.	15 cubic in.	1s. 3d.
2.	5 "	3 "	35 "	1s. 6d.
3.	6 "	3 "	40 "	2s.
4.	6 "	4 "	80 "	2s. 6d.
5.	7 "	5 "	135 "	3s.
6.	8 "	4 "	100 "	3s.
7.	8 "	6 "	225 "	4s.

No.	Height to Shoulder.	Diam.	Capacity.	Price.
8.	8 "	7 in.	300 cubic in.	5s.
9.	9 "	6 "	250 "	4s. 6d.
10.	9 "	7 "	340 "	5s. 6d.
11.	10 "	5 "	200 "	4s.
12.	10 "	8 "	500 "	6s.
13.	12 "	5 "	240 "	5s.
14.	13 "	5 "	250 "	5s. 6d.

2108. BELL GAS RECEIVERS, cylindrical form, with knob at the top, and stout welt round the mouth, ground flat, Fig. 2108, fine white Bohemian glass, well annealed.

Approximate Measurements as follow:—

No.	Height inside.	Diam.	Capacity.	Price.
1.	5 in.	2 in.	15 cubic in.	1s.
2.	5 "	3 "	30 "	1s. 6d.
3.	6 "	4 "	70 "	2s. 6d.
4.	7 "	5 "	130 "	3s.
5.	8 "	6 "	220 "	4s.

No.	Height inside.	Diam.	Capacity.	Price.
6.	8 in.	7 in.	300 cubic in.	5s.
7.	10 "	8 "	500 "	6s. 6d.
8.	5 "	6½ "	160 "	4s.
9.	5 "	7½ "	200 "	4s. 6d.
10.	5 "	8½ "	280 "	5s. 6d.

109. BELL GAS RECEIVERS, with welted and ground mouth, and glass stopcock ground into the neck, fine white Bohemian glass, Fig. 2109.

No.	Height to Shoulder.	Diameter.	Approximate Contents.	Price.
1.	13 inches.	5 inches.	250 cubic inches.	14s.
2.	16 "	6 "	450 "	16s.

110. GLASS CYLINDERS WITH BRASS CAPS, for collecting gases, and conveying them into exhausted glass globes, balloons, &c., welted mouths, ground, Fig. 2110, a and c.

No.	Height.	Width.	Contents in cubic inches.	Price.
1.	7 in.	4 in.	100	3s.
2.	8 "	5 "	160	4s.
3.	9 "	4 "	100	3s. 6d.
4.	10 in.	5 in.	200	4s. 6d.
5.	11 "	5 "	220	4s. 6d.

No.	Height.	Width.	Contents in cubic inches.	Price.
6.	9 "	6 "	250	4s. 6d.
7.	12 "	6 "	340	5s. 6d.
8.	14 "	6 "	400	6s. 6d.
9.	9½ "	7 "	370	6s. 6d.

2111. If No. 2110 are Graduated into cubic inches, the extra price will be as follows :—

On Nos. 1 to 5, 3s. each.

On Nos. 6 to 9, 4s. each.

2112. Glass Cylindrical Gas Receiver, with spherical Receiver, and intermediate brass fittings, as represented by Fig. 2110.

1. Price of the Cylinder according to the sizes, see the table, No. 2110.

2. Price of the Globe and brass fitting, marked *b, d, e, f, g*, 10s.

The brass fittings of this apparatus are charged separately as follows :—

704. Connector *f*, Fig. 2110, 1s.

697. Stopcocks *e* and *g*, Fig. 2110, 3s. each.

713. Caps *c* and *d*, Fig. 2110, 1s. each.

2113. Glass Globes, with brass caps, suitable for use with the capped cylinders, No. 2110, two varieties :—

2113. Globe of Light Glass, for taking the specific gravity of gases, $4\frac{1}{2}$ inch diameter about 50 cubic inches' capacity, with small stopcock, extra screw to adapt it to the air-pump, and a hook for the balance ; the capacity marked on the globe, 7s.

2114. Globe of Stout Glass, about 5 inches diameter, with brass cap, not graduated *b, d*, Fig. 2110, 3s.

2115. Large Glass Globular Receivers, for collecting oxygen gas, see No. 2224.

2116. Glass Globe, with ground glass stopcock and jet, fine hard white Bohemia glass, Fig. 2116.

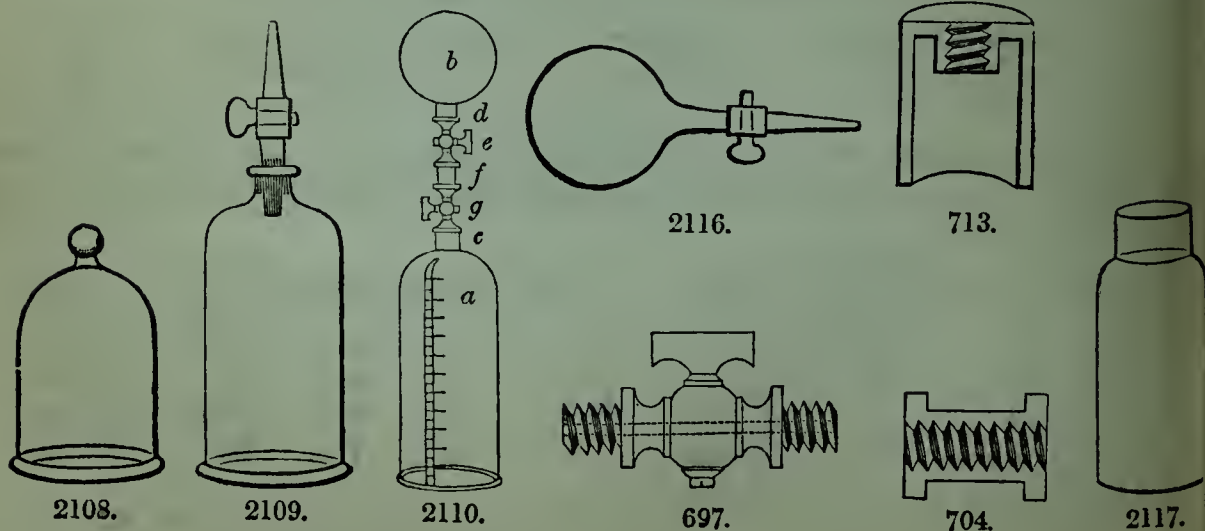
a. Contents about 70 cubic inches, 10s.

b. „ „ 100 „ 12s.

c. „ „ 140 „ 14s.

2117. Deflagrating Bottles, of the form of Fig. 2117, for collecting gases, for performing deflagrations in oxygen, &c., hard white Bohemian glass, thin but uniform in substance, the necks cylindrical, flat ground mouth, not welded. The following sizes :—

No.	Height to Shoulder.	Diameter.	Width of Mouth.	Contents.	Price.
1.	5 inches.	$2\frac{1}{2}$ inches.	$1\frac{3}{4}$ inches.	25 cubic inches.	9d.
2.	6 „	3 „	$2\frac{1}{2}$ „	50 „	1s.
3.	7 „	4 „	3 „	80 „	1s. 3d.
4.	8 „	5 „	$3\frac{1}{2}$ „	160 „	1s. 6d.



2118. Cylindrical Jars on feet, with strong flange at the mouth, Fig. 2118. The sizes and prices are given at No. 1534, page 158.

The prices of glass discs for covering Jars, *c* Fig. 2118, are given at Nos. 1677 and 1685.

If the Jars described at No. 2118 are *ground at the mouth*, the price of each will be 2d. to 4d. extra.

2119. Gas Receivers, in the form of wide-mouthed bottles, hard German glass, with ground stoppers, stout glass, Fig. 2119.

1 pint, 1s.	3 pints, 1s. 9d.	5 pints, 2s. 9d.
2 pints, 1s. 6d.	4 „ 2s.	6 „ 3s. 6d.



2118.

Figure 2119 represents two such bottles put mouth to mouth, with two glass discs placed between them. If the bottles are respectively filled with muriatic acid gas and ammonia gas, each bottle being secured by a glass plate, the two gases mix together when the two glass plates are removed.



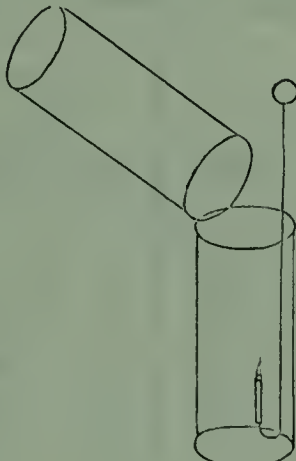
2119.



2120.



2122.



2121.



a.



b.



c.

2124.

2120. Gas Receivers in the form of Bottles, with extremely wide necks (4 to 5 inch), hard Bohemian glass, thin in substance, with glass stoppers ground, but not accurately fitted:—

1 pint, 9d.	4 pints, 1s. 8d.	12 pints, 3s.
2 pints, 1s.	6 „ 2s.	15 „ 4s.
2½ „ 1s. 2d.	8 „ 2s. 4d.	18 „ 5s. 6d.
3 „ 1s. 4d.	10 „ 2s. 8d.	20 „ 6s.

21. Cylindrical Jars for collecting gases, flat bottoms, uniformly thin in glass, not ground on the mouth, form of the jars in Fig. 2121.

No. 1. 2½ inch by 1½ inch, 3d.	No. 5. 6½ inch by 3¼ inch, 8d.
2. 3 „ 1¾ „ 4d.	6. 7 „ 3½ „ 10d.
3. 4 „ 2 „ 6d.	7. 8 „ 4½ „ 1s. 4d.
4. 5 „ 2½ „ 7d.	8. The set of seven jars, 4s. 6d.

No. 9. The set of four small sizes, No. 1 to 4, 1s. 8d.

Cylindrical Jars of stout Glass, see Nos. 1516, and 1530.

2122. Cylindrical Gas Tubes, or Eprouvettes, for collecting hydrogen and other gases, stout white glass, Fig. 2122.

No.	Length.	Width.	Contents.	Price.
1.	4 inches long,	1 inch wide,	2 cubic inches,	3d.
2.	5 "	1 $\frac{1}{4}$ "	5 "	4d.
3.	6 "	1 $\frac{1}{2}$ "	8 "	6d.
4.	7 "	1 $\frac{3}{4}$ "	10 "	7d.
5.	9 "	1 $\frac{3}{4}$ "	15 "	9d.
6.	12 "	2 "	30 "	1s.
7.	11 "	3 "	60 "	1s. 3d.

2123. *The above if ground at the mouth, 1d. to 2d. each extra.*

2124. Straight Tubes for collecting Gases, in experiments with small quantities. The short sorts particularly adapted for use with the mercury troughs, No. 2085. With these tubes gases can be collected, mixed together, or be mixed with liquids, &c. Made of hard and strong German glass, closed at one end, not graduated. Fig. 2124 a, b, c.

The following measurements are not given as accurate, but merely to afford an idea of the approximate sizes and capacities of the Tubes.

GROUND ON THE MOUTH.					NOT GROUND ON THE MOUTH.				
No.	Length. Inches.	Width. Inches.	Cubic Inches.	Price.	No.	Length. Inches.	Width. Inches.	Cubic Inches.	Price.
1.	1 $\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{8}$	2d.	7	3	$\frac{1}{2}$	$\frac{2}{3}$	2d.
2.	2	1	1 $\frac{1}{4}$	2d.	8	6	$\frac{1}{2}$	$\frac{3}{4}$	2d.
3.	3	$\frac{5}{8}$	1	2d.	9	2	$\frac{3}{4}$	$\frac{3}{4}$	2d.
4.	6	$\frac{3}{4}$	1 $\frac{3}{4}$	3d.	10	4 $\frac{1}{2}$	$\frac{1}{2}$	1	3d.
5.	4	1	2 $\frac{1}{2}$	3d.	11	6	$\frac{3}{4}$	1 $\frac{3}{4}$	3d.
6.	6	1	3 $\frac{1}{2}$	3d.	12	8	$\frac{5}{8}$	2 $\frac{1}{2}$	3d.
					13	6	1	3 $\frac{1}{2}$	3d.

2125. Straight Tube for collecting gases. The following tubes are more even in the bore than the foregoing. They are not ground on the mouth.

No.	Length. Inches.	Width. Inches.	Cubic Inches.	Price.	No.	Length. Inches.	Width. Inches.	Cubic Inches.	Price.
1.	6	$\frac{5}{8}$	1 $\frac{1}{4}$	6d.	6.	12	1	7	9d.
2.	9 $\frac{1}{2}$	$\frac{1}{2}$	1 $\frac{1}{2}$	6d.	7.	12	1	8	9d.
3.	11	$\frac{5}{8}$	2	6d.	8.	13	1 $\frac{1}{4}$	10	1s.
4.	12	$\frac{5}{8}$	2 $\frac{1}{2}$	8d.	9.	19	1 $\frac{5}{8}$	30	1s. 3d.
5.	10	1	6	8d.	10.	23	1 $\frac{3}{4}$	40	1s. 6d.

2126. Gas Tubes graduated into cubic inches or centimetre cubes are described in another section.

For other sizes of Plain Glass Cylinders, see Nos. 2121 and 2122.

2127. Schrotter's Gas Receiver, Fig. 2127, made of hard German glass tube, bulb 1 $\frac{1}{2}$ inch, tube 5 inch by $\frac{5}{8}$ inch, 8d.

2128. Cooper's Receiver, for collecting Gases over Mercury, and for experimenting on the gases without the help of a Pneumatic Trough or of other Receivers, Fig. 2128.

- No. 1. 8 inches long, $\frac{5}{8}$ inch wide, 8d.
 2. 10 " $\frac{3}{4}$ " 10d.
 3. 12 " 1 " 1s.

The following with a neck and stopper at the upper end.

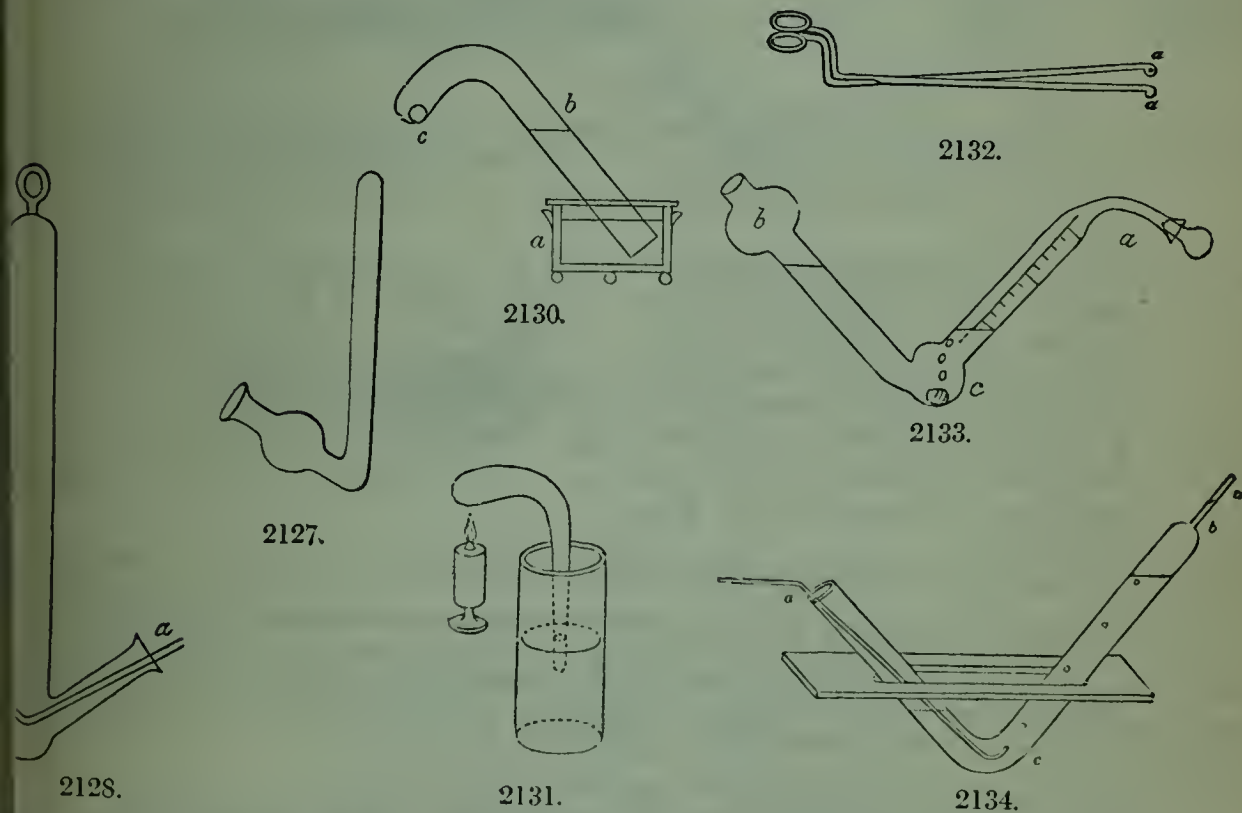
- No. 4. 8 inches long, $\frac{5}{8}$ inch wide, 1s.
 5. 12 " 1 " 1s. 3d.

2129. Cooper's Gas Receivers, graduated into cubic inches or centimetre cubes at from 2s. to 4s. extra.

2130. Gay Lussac's Bent Tube Receiver, (cloche courbée,) for applying heat to substances in gases, over mercury, hard glass tube. Fig. 2130.

- No. 1. 10 inches long, $\frac{1}{2}$ inch wide, 8d.
 2. 12 " $\frac{3}{4}$ " 10d.

2131. Davy's Apparatus for the same purpose, Hard Glass Retort, Fig. 2131, 1s.



2132. Iron Tongs, having hemispherical cavities at their points, for passing metals, such as potassium, through mercury into gases, contained in Receivers such as Nos. 2130 and 2131, 15 inches long, polished iron, 6s.

2133. Kerr's Gas Tube, for collecting and measuring the carbonic acid gas discharged when a carbonate is decomposed by an acid, Fig. 2133 :—

1. Plain Tube, 14 to 16 inches long, $\frac{1}{2}$ inch wide, 1s. 6d.
 2. Ditto, graduated into cubic inches, 4s. 6d.
 3. Ditto, graduated into centimeter cubes, 4s. 6d.

an acid being put into the branch *a*, and a solid (carbonate of lime) into the cavity *c*, the gas which is disengaged is collected in the branch *a*, where it is measured by the scale, and from which it can be transferred for examination.

2134. Berzelius's Bent Tube Receiver for collecting Gases over Mercury without a Trough, Fig. 2134, 1s. 6d.

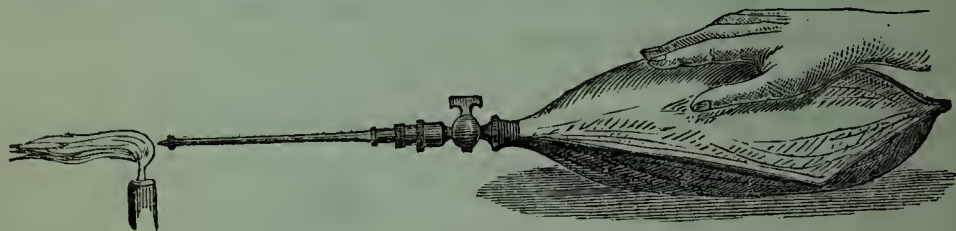
A gas-delivery tube may be connected by a caoutchouc tube and pinchcock to the small end *a b* of the receiver, and the gas be thence transferred to other tubes, its place being occupied by mercury poured into the open end of the receiver.

2135. Plain Glass Cylinder, open at both ends, for experiments on ventilation, &c., 2 inches diameter and 10 inches long, 6d.

GAS BAGS.

Gas Bags and all preparations of caoutchouc are subject to great variations in price.

2136. Gas Bag, of Macintosh's waterproof cloth, 18 inches by 13 inches, with brass ferule and female screw to fit the stopcock, No. 697, 10s.

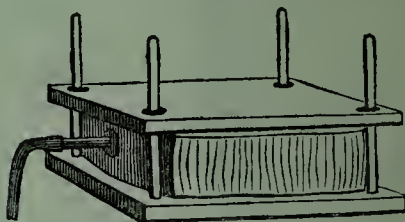


2137.

2137. Ditto, with stopcock and blowpipe jet, as shown in Fig. 2137, 14s. 6d.

2138. Larger Gas Bag, of waterproof cloth, with gusset, measuring 18 inches long, 13 inches wide, and $4\frac{1}{2}$ inches deep, with brass ferule and female screw, 14s.

2139. Gas Bag, of waterproof cloth, 15 inches long, 15 inches wide, and 5 inches deep, with brass ferule, and female screw at one end; mounted in a frame, consisting of a wooden base, four vertical iron rods, and a plate of cast iron weighing about 30 lbs., Fig. 2139, 24s.



2139.



2143.

2140. The Gas Bag, No. 2139, with the ferule, but without the pressure frame, 14s.

To fill the bag, the iron pressure plate is lifted off, and the gas is forced into the bag in the usual way, and is secured by a stopcock. When the gas is wanted, the pressure is applied by the iron plate, and increased if necessary by other weights. The vertical rods unscrew, so that the whole gas-holder can be packed in a small compass for travelling. The blast of air or gas given by this apparatus is extremely regular, and well suited for blowpipe operations.

2141. Bladders, bullocks', prepared for use, 6d.

2142. Bladders, bullocks', prepared for use, and mounted with brass collar, 2s.

2143. Bladders, bullocks', large size, prepared for use, with wooden mouthpiece Fig. 2143, for use when nitrous oxide gas is to be breathed, 2s.

2144. Bladders, cleaned and coloured, suitable for the lecture room, mounted with brass collar, 2s. 6d.

2145. Sheep's Bladders, cleaned, each 2d.

Bladders should be occasionally washed with a mixture of water and glycerine, to prevent their cracking into holes.

2146. Gas Bag, soft and strong, made of goldbeaters' skin, but very thick, spherical 11 inches diameter, fastened to a connector with female screw, 6s.

2147. Gas Bag, same as the preceding, but 15 inches in diameter, with socket, 8s.

2148. Gas Bags, of solid vulcanised caoutchouc, globular form when filled, with brass ferule and female screw. Sizes from 10 inches to 18 inches diameter. Price according to weight, at 10s. 6d. per pound.

a. Caoutchouc Bag, of 9 inches diameter, costs about 4s. 6d.

b. Ditto, of 13 inches diameter, costs about 10s.

STOPCOCKS and CONNECTORS for Gas Bags are described at page 67.

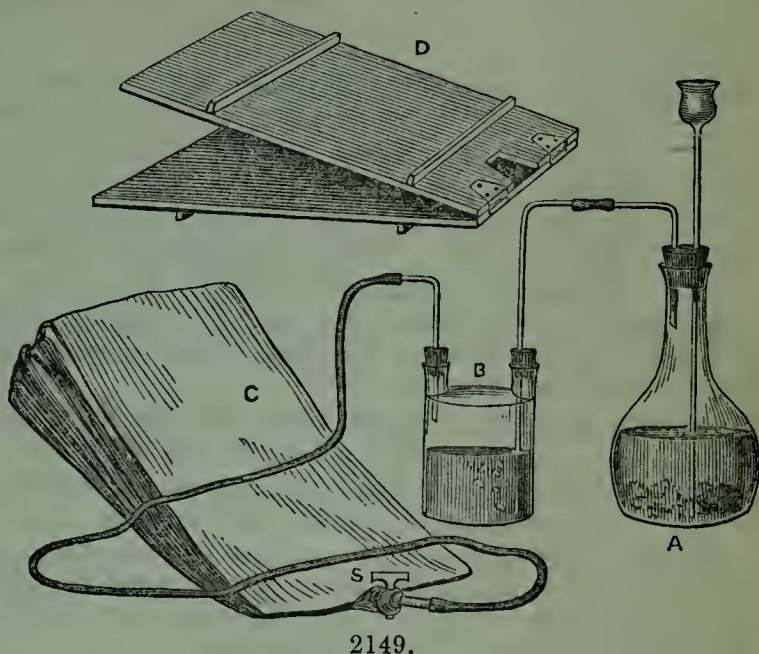
2149. GAS BAGS OF LARGE SIZE, for use at Lectures with dissolving views or microscopes, wedge shaped form, C, Fig. 2149.

There are two qualities of Gas Bags, namely:—

1. Black Stout Twilled Sheet Rubber-lined Bags.

2. Drab Jeanette Bags of thinner material.

The prices of several sizes, from 2 to 16 cubic feet in capacity, are quoted in the following table; but these prices are subject to frequent variation, according to the market price of the material.



2149.

Fig. 2149 represents an apparatus for preparing hydrogen gas in large quantity. A the gas bottle, B the wash bottle, C the bag receiver, D the pressure boards, No. 2150.

No.	Inches long.	Inches wide.	Inches Wedge	Contents in		Black Twilled.	Drab Jeanette.
				Cubic inches.	Cubic feet.		
1.	24	20	18	4,320	2½	£2 10s.	£1 12s.
2.	30	20	20	6,000	3½	3 3	2 -
3.	30	24	20	7,200	4⅙	3 10	2 5
4.	36	24	20	8,640	5	4 -	2 11
5.	36	30	20	10,800	6¼	4 15	3 -
6.	44	25	20	11,000	6⅓	4 18	3 -
7.	40	32	20	12,800	7½	5 8	3 8
8.	45	35	20	15,750	9⅓	6 6	4 3
9.	40	36	24	17,280	10	6 6	4 3
10.	48	36	30	25,920	15	8 4	5 -
11.	52	36	30	28,080	16¼	9 9	

149a. STOPCOCK, for any size of bag, 4s. extra.

150. PRESSURE BOARDS, D, Fig. 2149. These need to be made about two inches wider and larger than the bags. In use they are pressed by large iron weights or stones, which are supported by the bars placed across the upper board D, Fig. 2149.

4. Price of Boards for No. 4 Bag, 12s. 6d.

5. „ „ No. 5 „ 16s.

GAS HOLDERS.

2161. GRIFFIN'S SCHOOL GAS HOLDER, japanned zinc, cylindrical, 18 inches high, $10\frac{1}{2}$ inches diameter; contents 1500 cubic inches, with stopcock, large funnel on an 18-inch tube, 3 feet of vulcanized rubber tube, for delivering the gas, and a wide gauge pipe. The gas holder graduated into spaces of 50 cubic inches, Fig. 2161, 28s.

The fittings of the gauge pipe are so constructed that, if the glass tube should happen to be broken, it can be easily replaced by another, the screw *h* being moveable.

2162. Stopcock, with large bore, to use with the above gas holder, for hydraulic experiments. There is an opening near the bottom of the gas holder, provided with a screw fitted to this stopcock, 4s.

See "Chemical Recreations," page 175, and Fig. 2161, *e*, *i*, and *k*. The stopcock *e* is also useful when the apparatus is to be used as an aspirator, the vessel through which air is to be drawn being then put into connection with the stopcock *g*.

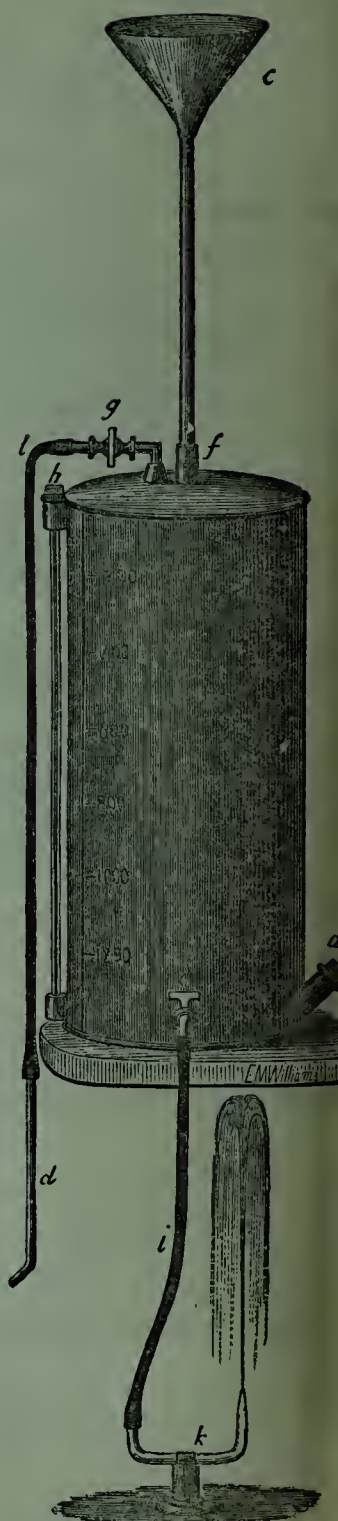
2163. Griffin's School Gas Holder, the model and size of No. 2161, but made of copper, 45s.

2164. Incorrodible Saltglazed Stoneware Gas Holder; contents $1\frac{1}{2}$ gallon, with japanned funnel, brass stopcock, soft metal gas pipe, and connectors, as represented by Fig. 2164, letters *a* to *g*, 10s.

2165. Ditto, larger size; contents 3 gallons, 15s.



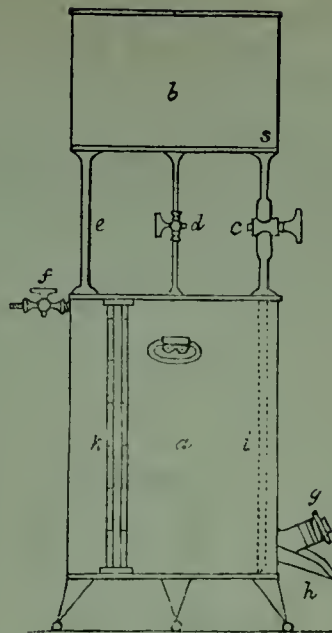
2164.



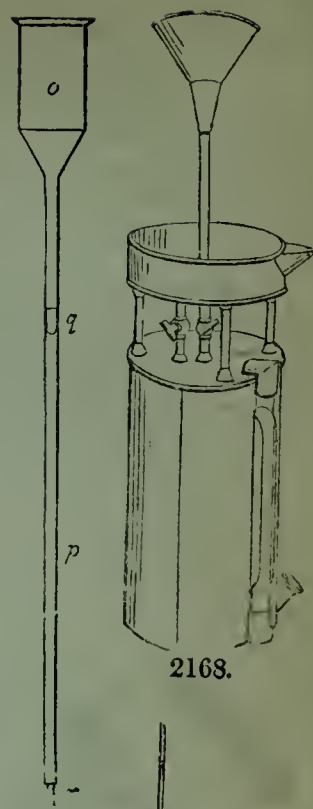
2161.

2166. Pepys's Gas Holder, Fig. 2166.

This differs from No. 2161, by having a deep trough fitted above it and put in communication with it. Contents of the gas holder, about 2000 cubic inches, with gauge pipe graduated to show hundreds of cubic inches, a pressure funnel, and 3 brass stopcocks, 50s.



2166.



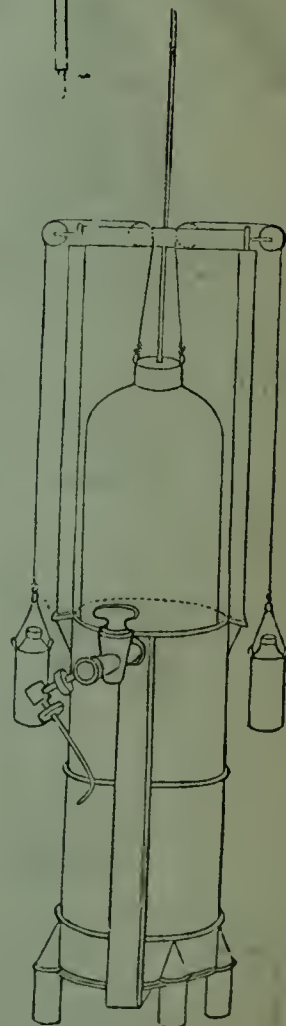
2168.

2167. Pepys's Gas Holder, form and size of No. 2166, but made of copper, £5.

2168. Pepys's Gas Holder, 4 gallons, shallow trough, japanned tinplate, Fig 2168, 30s.

2169. Pepys's Gas Holder, small size, contents 1200 cubic inches, with funnel and stopcock, without trough or gauge, 12s.

2170. BELL-SHAPED GASOMETER, similar to Fig. 2170, but having the counterpoises and strings enclosed in a frame of tubes, which takes asunder for packing; size of the bell receiver, 12 by 11 inches, with two stopcocks, and four connectors, japanned tinplate, without the jet shown in the Figure, £2 2s.

2171. Bell-shaped Gasometer, general form of Fig. 2170, made of japanned zinc, with frame, which takes asunder for packing, and cover to press down the Bell when in action; the lower receiver with expanded mouth to prevent the overflow of water; dimensions of the bell receiver 20 inches wide, 36 inches high, contents about $6\frac{1}{2}$ cubic feet, or 40 gallons, price £5 5s.

2170.

This Gasometer will contain oxygen gas sufficient to supply two large magic lanterns during a long entertainment. It is suitable for export hot climates, where the bags made of waterproof cloth cannot be depended upon.

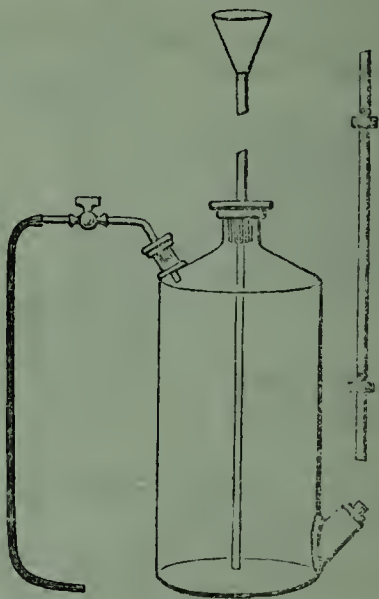
2172. Glass Gas Holder; Bohemian glass, contents about 6 gallons, size 16 inches high, 12 inches diameter, with brass cap and fittings, japanned tin funnel and long pressure pipe with brass stopcock, and 3 foot caoutchouc gas delivery tube, Fig. 2172, £2 12s. 6d.

2173. Glass Gas Holder, Fig. 2173, white French glass, the pressure funnel fixed on a long metal tube with two union joints, brass stopcock, and vulcanized caoutchouc gas delivery tube. *Two sizes:—*
2173. Reservoir 15 inches high, 8 inches wide. Contents 20 pints, 26s.
2174. Reservoir 18 inches high, 10 inches wide. Contents 36 to 40 pints, 33s.
2175. Williams's Gas Holder and Retort for preparing oxygen gas, combined 60 ounce bottle, 3s. 6d.

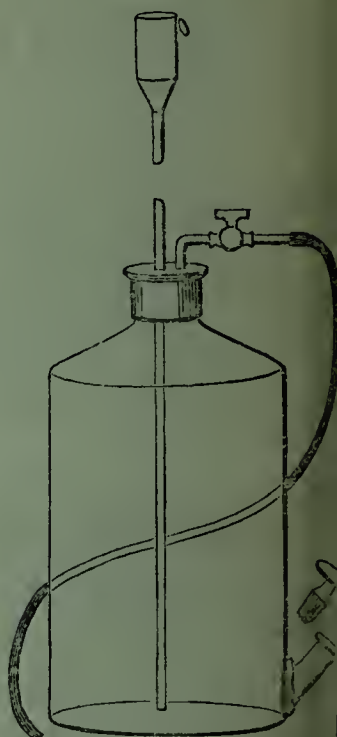
Described in "Chemical Recreations," page 176. The purpose of it is, to collect the gas in the receiver in which the experiment is to be made, without using a trough. To effect this, the receiver is first filled with water, which is run off by a syphon as the gas is received.



2175.

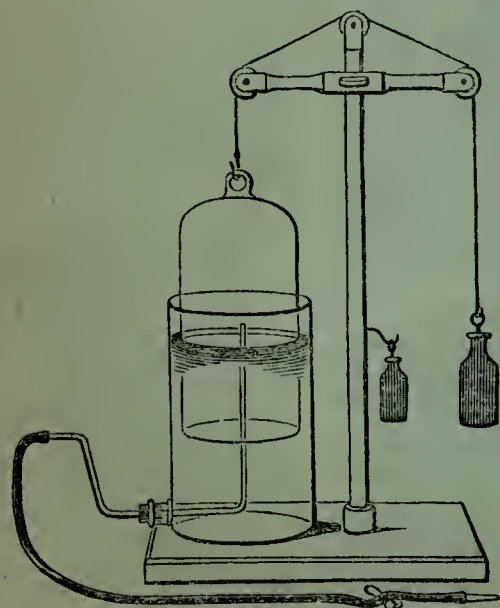


2173.



2172.

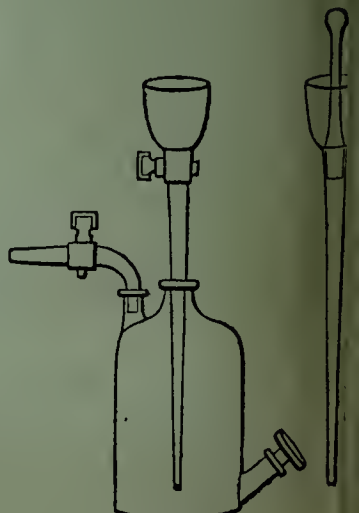
2176. Bohemian Glass Bell Gas Receiver, form of Fig. 2176. Size of outer cylinder 12 inches by 6½ inches; size of bell, 8 inches by 6 inches, with wooden frame, 3 pulleys, and counterpoises, 3 feet of caoutchouc tube, and a pinch cock, as represented in the Figure, 31s. 6d.



2176.



2177.



2178.

2177. Bunsen's Glass Gas Holder, for mercury, Fig. 2177, graduated. Size of receiver 2 inches diameter, and 6 inches high to shoulder, scale extending to 100 millimeters. See Bunsen and Roscoe's Gasometry, page 20. Price, without tubes, 6s.

If desired, similar gas holders can be supplied, with graduations to show internal capacity, expressed in centimeter cubes or cubic inches.

2178. Schrotter's Gas Holder for Chlorine, for use when substances are to be heated (in tubes) in a continuous current of chlorine gas. The liquor to be used for expelling the gas is a solution of chloride of calcium. The flow of it is regulated either by a glass stopcock on the neck of the funnel, or a long glass stopper ground into the funnel; both of these are shown in Fig. 2178. With glass stopcock on the out-flow tube, and stoppered neck at the side. Size of the gas holder, 13 inches high and 9 inches wide; contents about 25 pints, or 800 to 900 cubic inches.

2178. With the ground stopper in the funnel, 30s.

2179. With a glass stopcock to the funnel, 35s.

CONDENSATION AND ABSORPTION OF GASES.

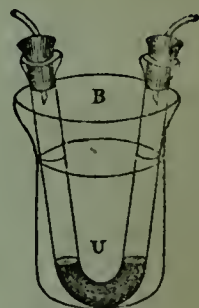
2186. TUBE CONDENSERS, or substitutes for Woulff's Bottles, for preparing solutions of gases in small quantities, U-form, Fig. 2186.

2186. Length of tube 12 inches, bore $\frac{1}{2}$ inch, 9d.

2187. Length of tube 18 inches, bore $\frac{3}{4}$ inch, 1s.

2188. Length of tube 21 inches, bore 1 inch, 1s. 3d.

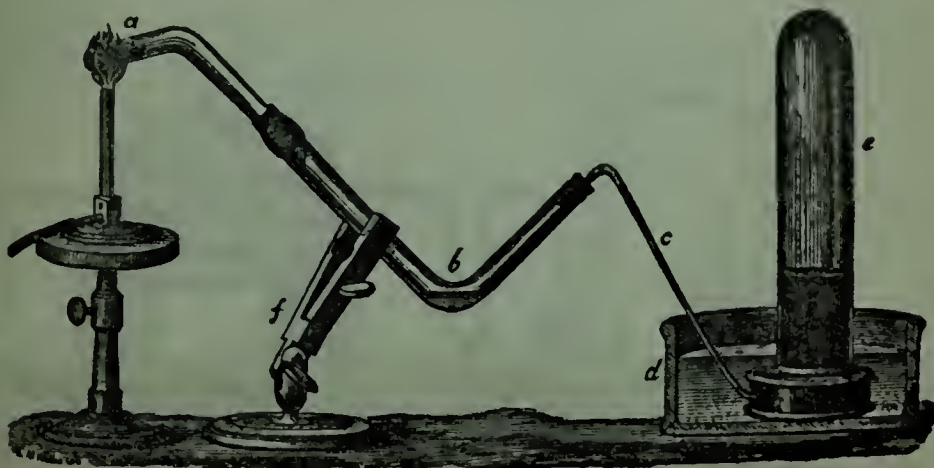
2189. Connecting Tube, bent at a proper angle, to connect the U-tube with a gas bottle, *h* Fig. 1941, 4d.



2186.

The use of the above apparatus is illustrated in "Chemical Recreations," p. 330. When the Condenser contains a small quantity of water, and is immersed in iced water contained in a beaker, a saturated solution is easily procured of any gas that is absorbable by water, such as Ammonia.

This apparatus also serves for washing or drying gases, or for trying their action on different solutions.



2192.

Tube Condensers, V-form, Fig. 2190.

2190. Length of tube 9 inches, bore $\frac{5}{8}$ inch, 6d.
 2191. Length of tube 12 inches, bore $\frac{3}{4}$ inch, 9d.
 2192. Length of tube 9 inches, bore $\frac{5}{8}$ inch, legs unequal, *b* Fig. 2192, 6d.
 2193. Connecting Tube, form of *i* Fig. 1941, 4d.
 2194. Liebig's Gas Absorber, or tube for saturating a liquid with a gas, Fig. 2194. The large Tube, 9 or 10 inches long, $\frac{5}{8}$ inch wide, 8d.

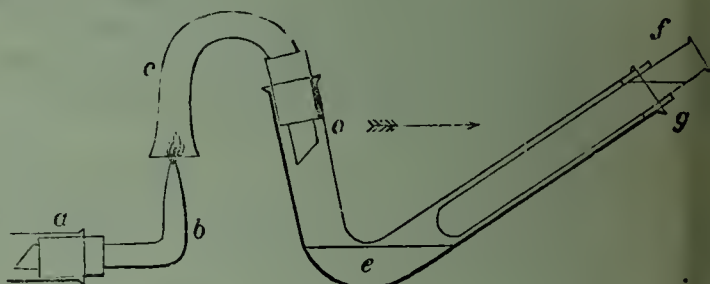


2190.

The liquid is contained in the bent part; the narrow end, *a*, is connected with the gas bottle. Useful in preparing a small quantity of the solution of any gas. Used by Liebig for the preparation of chloral, by passing chlorine gas into alcohol.



2194.



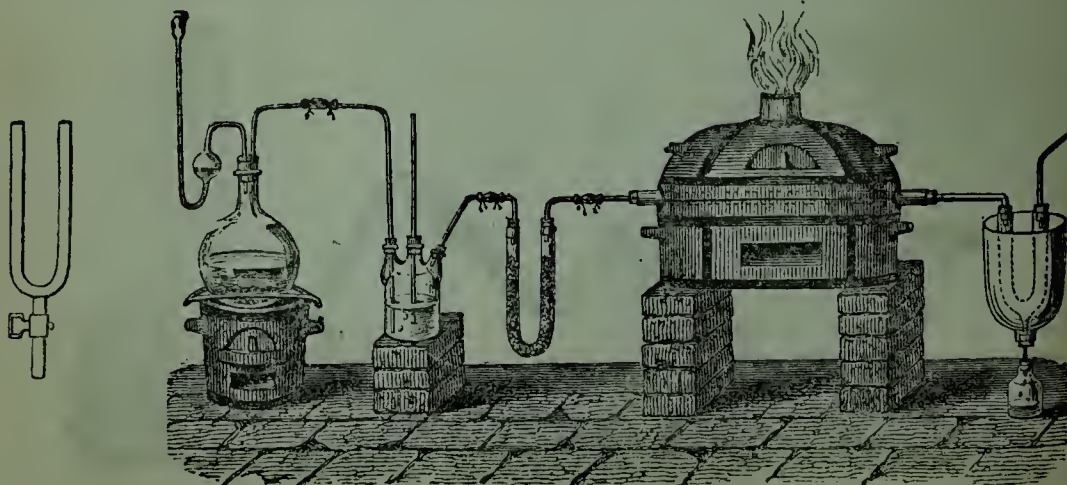
2195.

2195. Apparatus for an Experiment to prove, that when Hydrogen Gas is burnt in the air, water is produced. This consists of 5 glass tubes connected, as shown in Fig. 2195, 3s., *fitted*.

a, Chloride of Calcium tube to dry the hydrogen gas; *b*, infusible glass jet at which the gas is burnt; *c*, infusible glass connecting tube; *e*, condensing tube; *f*, tube filled with cold water, to condense the water formed by the gas. The tube *f* is supported at *g* by two slips of cork. The flame at the mouth of *b* should be about half an inch long. This flame causes a current of air to pass through the tubes *c*, *o*, *g*. The oxygen combines with the hydrogen, and forms water, which condenses at *e*. The nitrogen and excess of air escape between *f* and *g*. In half an hour a quantity of water can be collected at the bend *e*.

2196. Condenser for Vapours, such as hydrocyanic acid, U-form, provided with a glass stopcock for drawing off the condensed liquor; solid Bohemian glass, Fig. 2196, 8s.

This condenser is mounted for use in an inverted deflagrating jar, the neck of which is closed by a cork, through which the neck of the condenser is passed. The jar is filled with iced water, or such other cooling mixture as the experiment renders necessary. See Fig. 2197.

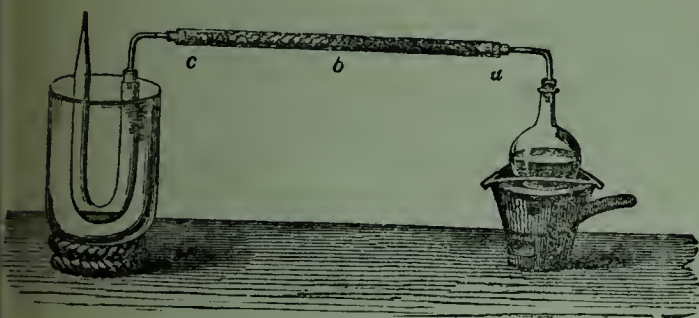


2196.

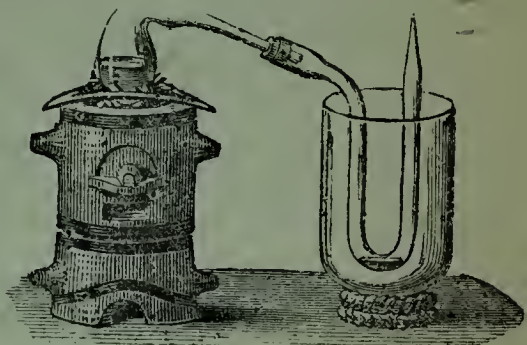
2197.

2197. Condenser, U-form, with a neck at the bent part for delivering the condensed liquor into another vessel, without removing the condenser from the freezing mixture, the latter being placed in an inverted bell receiver, Fig. 2197; length of bent tube 16 inches, bore $\frac{1}{2}$ inch, 1s. 3d.

This condenser is represented in Fig. 2197, which is Regnault's apparatus for preparing chloride of silicon. The condenser is at the right-hand end of the series of apparatus. To prepare chloride of silicon, chlorine gas, prepared in the gas bottle at the left-hand end of the figure, is passed through the wash bottle and the drying tube, and then over a mixture of silica and lamp black, heated to redness in a porcelain tube which traverses the furnace. The chloride of silicon is condensed by the freezing mixture contained in the bell jar, and is received in the bottle placed below it.



2198.



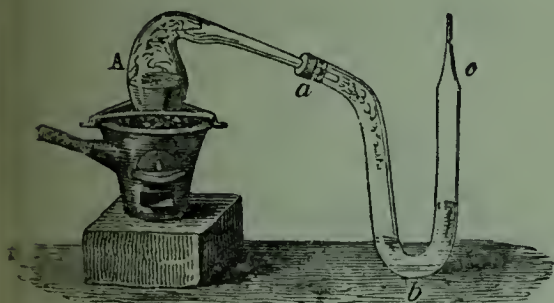
2199.

2198. Condenser for Vapours that require a freezing mixture, U form, Fig. 2198, which represents the apparatus for preparing anhydrous hydrocyanic acid. See "Chemical Recreations," page 528. Length of tube 15 inches, bore $\frac{1}{2}$ inch, 10d.

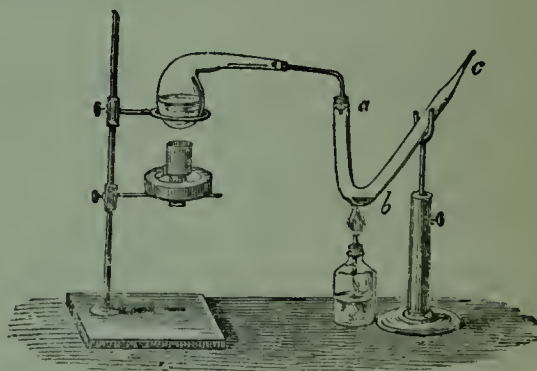
2199. Bent Tube Receiver used in the preparation of liquid Peroxide of Nitrogen, and for the distillation of phosphorus. See "Chemical Recreations," pages 292 and 634, Fig. 2199.

a. Small size, length of tube 16 inches, bore $\frac{1}{2}$ inch, 1s.

b. Large size, length of tube 20 inches, bore $\frac{7}{8}$ inch, 1s. 6d.



2200.

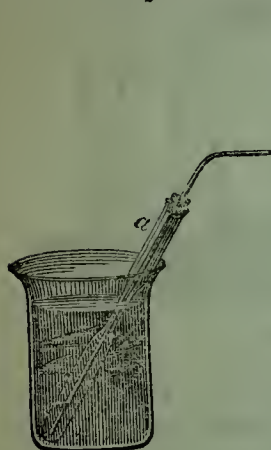


2201.

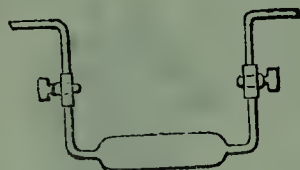
2200. Large U-shaped Receiver, suitable for the condensation of distilled phosphorus, Fig. 2200. See "Chemical Recreations," page 634. Length of tube 22 inches, bore 1 inch, 1s. 9d.
2201. Bent Tube V-form, Fig. 2201, used in the preparation of selenious acid. See "Chemical Recreations," page 631. Length of tube 15 inches, bore $\frac{3}{4}$ inch, 1s.
2202. TUBE APPARATUS FOR CONDENSING ANHYDROUS GASES, such as Cyanogen or Sulphurous Acid, into Liquids, by means of freezing mixtures:—
2203. Tube 8 inches by $\frac{3}{4}$ inch, with narrow neck, a Fig. 2202, 5d.

The gas being condensed by the freezing mixture contained in the glass beaker, the leading tube withdrawn, and the receiver is closed before the blowpipe at the narrow neck, assuming the form of Fig. 2203.

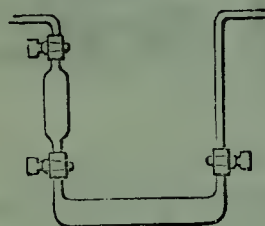
2204. Tube of the form of Fig. 2205, but without Stopcocks, the wide part of the tube measuring 4 inches by $1\frac{1}{4}$ inch, 1s.
2205. Tube of the form of Fig. 2205, with 2 stopcocks, the wide part measuring $2\frac{1}{2}$ inches by $\frac{7}{8}$ inch, 5s. 6d.
2206. Tube of the form of Fig. 2206, with 2 stopcocks, the wide part measuring $2\frac{1}{2}$ inches by $\frac{7}{8}$ inch, 5s. 6d.
2207. Tube of the form of Fig. 2207, with 3 stopcocks, intended to permit the liquid to be drawn off in small portions, the wide part measuring 4 inches by $1\frac{1}{4}$ inch, 8s.
2208. Tube of the form of Fig. 2208, with 3 stopcocks, each wide part measuring $2\frac{1}{2}$ inches by $\frac{7}{8}$ inches, 7s. 6d.



2202.



2205.



2207.



2203.



2206.



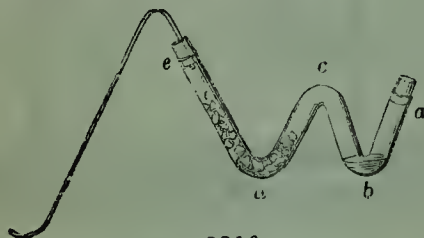
2208.

2209. Wohler's Apparatus for the absorption of substances produced during the analysis of metallic sulphides by the action of Chlorine gas, form of Fig. 2209:—

No.	Length of Tube.	Diameter of the Wide Tube.	Diameter of Bulbs.	Price.
1	10 inches.	$\frac{1}{2}$ inch.	$\frac{3}{4}$ inch	1s.
2	15 "	$\frac{7}{8}$ "	$1\frac{1}{2}$ "	1s. 9d.
3	18 "	1 "	2 "	2s. 6d.
4	Tube of U-form, with one bulb at bottom, each branch of the tube 7 inches by $\frac{3}{4}$ inch, 1s. 9d.			



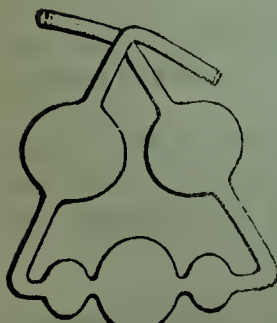
2209.



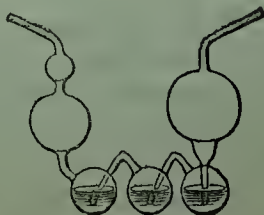
2210.



2211.



2213.



2214.



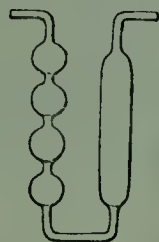
2215.

2210. Bent tube, W-form, Fig. 2210, used in the preparation of Hydrobromic Acid, see "Chemical Recreations," page 690, length of tube, 18 inches, bore, $\frac{3}{4}$ inch, 1s.
2211. Bent Tube, Fig. 2211, used to prove the direct formation of nitrates by electrical action, see "Chemical Recreations," page 298; length of tube, 18 inches, bore, 1 inch, 1s. 3d.

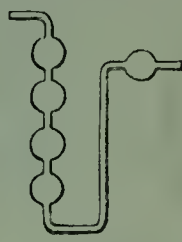
For the prices of the glass pans, such as used in No. 2211, see No. 1780.

2212. APPARATUS FOR THE ABSORPTION OF GASES BY LIQUIDS, in cases where the Apparatus and its contents are to be WEIGHED, both before and after the Absorption, in order to determine the exact quantity of gas absorbed:
2213. Liebig's Apparatus for the absorption of Carbonic Acid in a solution of caustic potash, Fig. 2213, in a box, 1s. 6d.
2214. Geissler's Apparatus for the same purpose, Fig. 2214, so formed as to stand steadily on 3 bulbs, in a box, 2s. 6d.
2215. Will and Varrentrapp's Apparatus, as improved by Horsford, for the collection of Ammonia Gas in Hydrochloric Acid, Fig. 2215, 8d.

2216. Mitscherlich's Apparatus for the absorption of Carbonic Acid by solution of caustic potash, Fig. 2216, bulbs, 1 inch, wide tube 6 inch by $\frac{3}{4}$ inch, 1s. 6d.



2216.



2217.

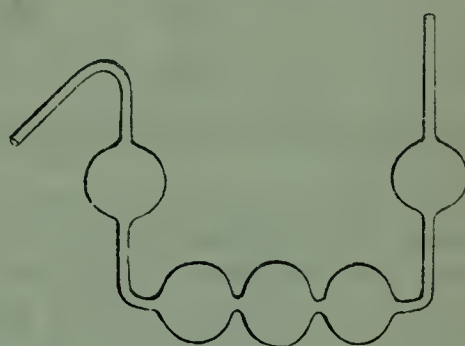


2218.

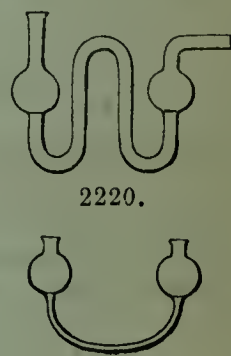
2217. Another form of Mitscherlich's Absorption Apparatus, Fig. 2217, bulbs, 1 inch, 1s. 3d.

2218. Modification of Will's Apparatus for the absorption of Ammonia by Hydrochloric Acid, Fig. 2218, 1s. 3d.

2219. Ure's Apparatus for the Absorption of Gases by Liquids, Fig. 2219, but made with 6 bulbs, namely four in the lower series, 1s. 9d.



2219.



2220.

2220. Double U-receiver, form of Fig. 2220, bulbs, $1\frac{5}{8}$ inch, tube $\frac{3}{4}$ inch wide, and 27 inches from end to end, 2s. 6d.

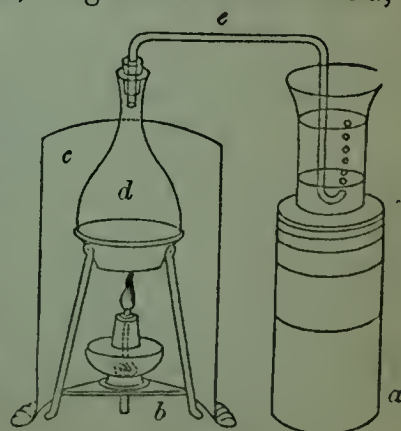
2221. Semicircular Tube, with two bulbs, Fig. 2221, diameter of bulbs, 3 inches, width of tube, $\frac{3}{8}$ inch, length from end to end, 20 inches, 2s. 6d.



2221.

2222. Apparatus for the preparation of Hydrofluosilicic Acid. Hydrofluosilicic Acid is prepared by passing gaseous fluoride of silicon into water. The fluoride of silicon is decomposed. Hydrofluosilicic Acid is produced, and solid silicic acid is deposited in such quantity as to stop up the end of the gas delivery tube, unless prevented by proper precautions. See "Chemical Recreations," page 706. In this apparatus the precaution represented is that of passing the gas into a stratum of mercury, placed under the water in the collecting beaker.

The pieces of this apparatus have been already priced. The locks *a* are No. 393; the tripod *b* is No. 295; the screen *c* is No. 296; the flask *d*, *e*, is similar to No. 2033; and the beaker is one of those described at No. 1440.



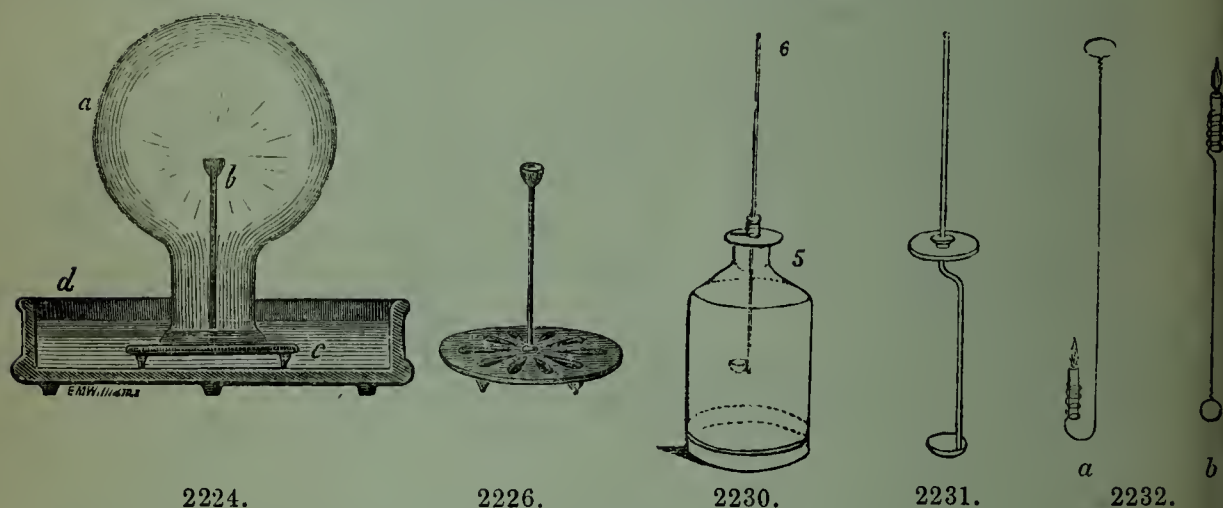
2222.

APPARATUS FOR CLASS EXPERIMENTS WITH GASES

2223. A considerable quantity of the apparatus described between No. 1935 and No. 2222, might very properly be placed under this head; but I only put here some articles that have escaped the analytical method of the preceding sections, or some apparatus which it is necessary to put together in a complex form, to show the method of combining the more simple instruments with one another to suit particular chemical demonstrations. This section, therefore, is not to be considered a complete in itself, but only as supplementary to the preceding sections relating to gas apparatus. A detailed account of the use of this apparatus is given in my work entitled "Chemical Recreations."

2224. Large Glass Globe, 8 to 9 inches in diameter, for burning phosphorus in oxygen gas, *a* Fig. 2224, 3s.

2225. Ditto larger, the globe about 12 inches in diameter, 4s. 6d.



2226. Metal Cup, on iron foot, to contain the phosphorus to be burnt in the oxygen globe, 1s. 6d.

2227. Flat Circular Stoneware Pan, 12 inches in diameter, for use in the same experiment, *d*, Fig. 2224, 2s.

2228. Deflagrating Jars, to contain oxygen gas for combustion. See No. 2101.

DEFLAGRATING SPOONS, to contain phosphorus, sulphur, &c, to be burnt in oxygen gas in the deflagrating jars:—

2229. Iron Bowl, iron wire, tinplate flange, and cork above it, to fix the wire at an required height, 6d.

2230. Brass Bowl, iron wire, brass flange, with cork to regulate the length of the rod, Fig. 2230, 1s.

2231. Brass Bowl, brass ground flange, and iron wire in stuffing box, 2s. 6d.

2232. Pair of Wax Tapers, mounted on copper wires, for trying the combustibility of gases, Fig. 2232; *a*, to plunge downwards into oxygen and heavy gases; *b*, to plunge upwards into hydrogen, &c., *per pair*, 6d.

2233. Hank of fine Iron Wire, to form spirals for combustion in oxygen gas, 6d.

2234. Hank of fine Steel Wire, for the same purpose, 1s.

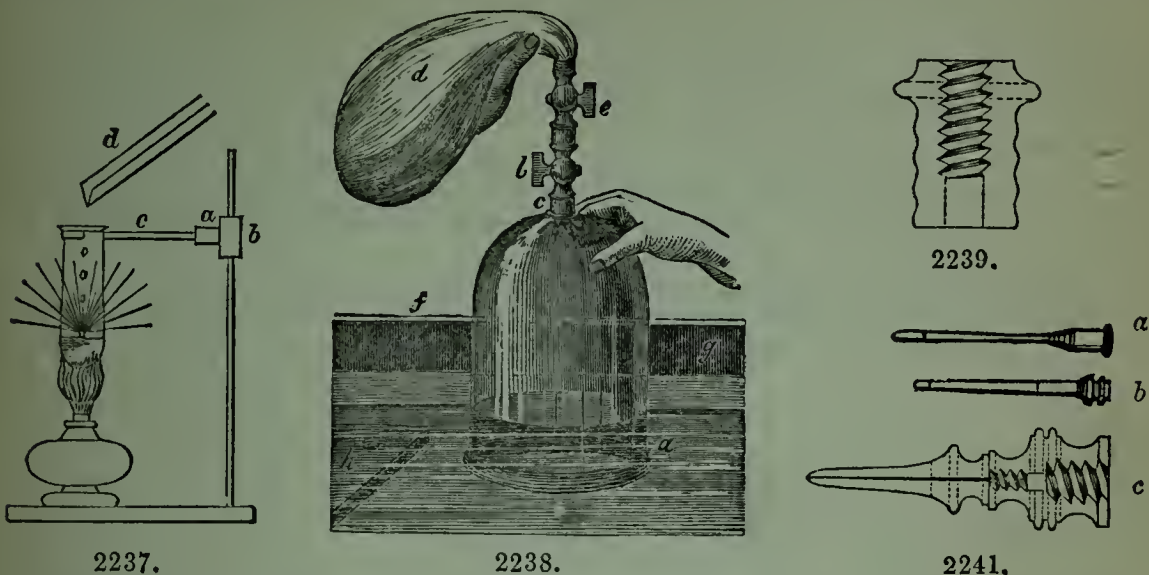
2235. Charcoal Bark, for burning with brilliant sparks in oxygen gas, *per ounce*, 2d.

2236. Cup with metal stand, similar to Fig. 2226, but smaller, for holding phosphorus to burn under an inverted gas jar in common air, 4d.

2237. Wide Hard Glass Test Tube, tin crook, and wooden support for deflagrating carbon, sulphur, or phosphorus in the oxygen gas given off by fused nitric acid, Fig. 2237, "Chemical Recreations," page 183, 2s.

2238. Apparatus for collecting a gas and transferring it into a bladder.

This apparatus is represented by Fig. 2238. The air receiver and its brass fittings have been described between Nos. 2110 and 2115. There remains the bladder to price. This is connected with a collar of the form of Fig. 2239, the screw of which has the same thread as the stopcock No. 697.

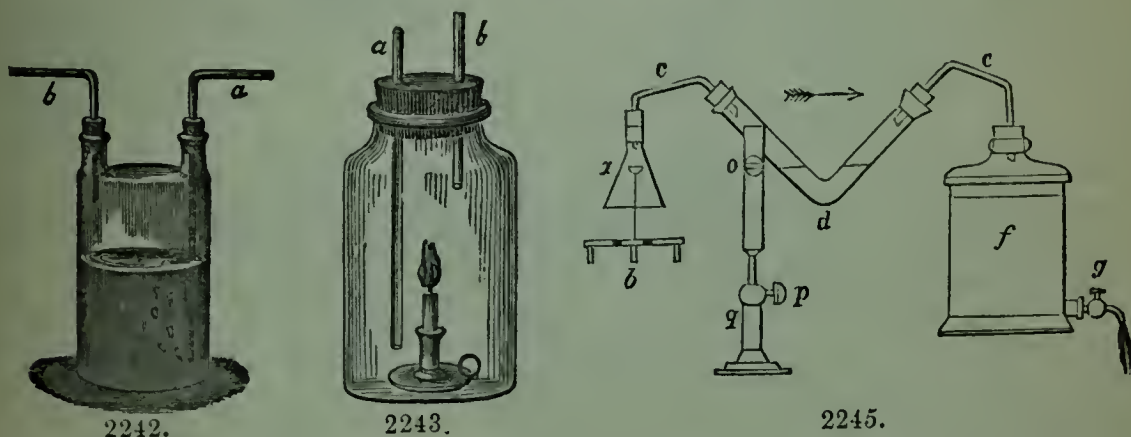
2240. Bladder, prepared, coloured, and mounted with brass bladder piece, *d*, Fig. 2238, 2s. 6d.

For other sizes of Bladders and Gas Bags, consult Nos. 2136 to 2150.

2241. Brass Blowpipe Jets, to be attached by a stopcock to a bag or bladder filled with oxygen gas, to direct a stream of oxygen upon metals burning on charcoal, Figs. 2241, *a*, *b*, *c*, each 2s.

2242. Apparatus to show the presence of Carbonic Acid Gas in air expired from the lungs, pint size, fitted with tubes, Fig. 2242. See "Chemical Recreations," page 272, 2s. 6d.

The bottle is supplied with lime water. If the mouth is applied at *b*, and air is sucked through the bottle, the lime water is scarcely altered; but if the mouth is applied at *a*, and air from the lungs is blown into the bottle, the lime water speedily becomes turbid.



2243. Apparatus for explaining Ventilation, consisting of a wide-mouthed bottle, half gallon size, with cork and two tubes, by the positions of which the ventilation is regulated, see "Chemical Recreations," page 553, 4s.

2244. Small candle holder, as represented in Fig. 2243, to fix a lighted taper within a glass cylinder or bottle in experiments on combustion or ventilation, 3d.

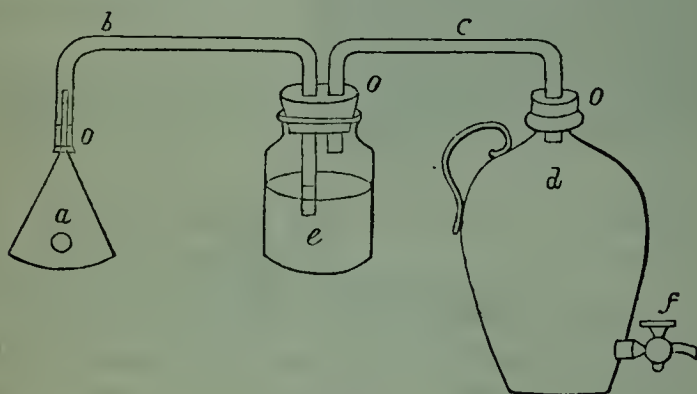
2245. Apparatus to collect the carbonic acid gas that is produced by the flame of a spirit lamp or candle, consisting of a glass funnel and three bent tubes, *a, c, d, e*, Fig. 2245, 2s.

2246. See "Chemical Recreations," page 343. The candle is placed within the funnel, instead of the support *b*. In *d*, clear lime water is placed. When water is made to run from the aspirator *f*, air is drawn through the apparatus in the direction of the arrow, and carries with it the carbonic acid produced by the flame. This acts upon the lime water in *d*, and renders it turbid. In the apparatus as represented by Fig. 2245, sulphur or phosphorus can be burnt in the cup *b*, and the acids produced be made to act upon liquids placed in the receiver *d*. Thus, sulphurous acid gas acting upon a yellow solution of chromate of potash changes its colour to green, in consequence of reducing the chromic acid.

2247. Fig. 2247 represents an apparatus, similar in principle, but suitable for operating on larger quantities than that represented by Fig. 2245. In this case, the substance to be burnt or oxidised is placed on a hot plate or tile below the funnel, and air is permitted to pass over it through the hole *a*.

2247. Price of the Apparatus, Fig. 2247, without the Aspirator, 4s.

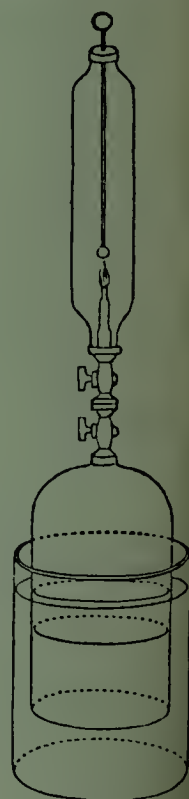
The Aspirators are priced at page 22.



2247.

2248. Davy's Apparatus for showing that a jet of oxygen gas can be burnt in an atmosphere of hydrogen gas, Fig. 2248, see "Chemical Recreations," page 214. Price of the upper glass receiver, with brass fittings, one stopcock and a platinum jet, 12s.

The Brass Stopcocks and lower receiver are priced at Nos. 2110 to 2112.



2248.

BALLOONS.

These Balloons are made of gold-beater's skin. When not in use, they should be kept in a close tin case, with a little camphor to preserve them from insects. They ought never to be wetted. When they are expanded with air from the mouth, the lips ought not to touch the mouth of the balloon. They will all ascend with dry coal gas. In filling a balloon the gas should be passed through a glass tube containing pieces of chloride of calcium, to free the gas from water. The large sizes of balloons, when in good condition, may be kept suspended two or three days, fastened by a string to the table. But the hydrogen gas is gradually exchanged for atmospheric air by osmotic action, and the balloon then descends. The hydrogen gas with which a balloon is to be filled must all be prepared before the filling is attempted, and should be contained in a gasholder, or in large jars provided with stopcocks.

2249. Prices of Spherical Balloons.

No. 1.	9 inches diameter,	1s. 3d.	No. 4.	15 inches diameter,	3s.
2.	10½	1s. 9d.	5.	18	5s.
3.	12	2s. 6d.			

The Balloons are usually coloured in gores, but the three smallest sizes of round balloons are also coloured plum-pudding pattern.

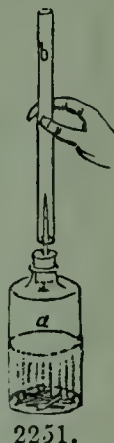
- No. 6. Oval Balloon, 3 feet high, 2 feet in diameter 15s.
 7. Balloon in the shape of Mr. Punch, 6 feet high, and 9 feet in circumference 63s.
 8. Balloon in the shape of an Elephant, 3 feet long and $2\frac{1}{2}$ feet high, well formed and coloured, and adjusted to ascend in proper position 35s.
 9. Spherical Balloon, 6 inches diameter, will rise with hydrogen gas, but not with coal gas 1s.

2250. Balloons of Collodion, extremely thin and light, for ascension with hydrogen gas. Several sizes, 4 inches to 6 inches diameter, 1s. 9d. to 3s. each.

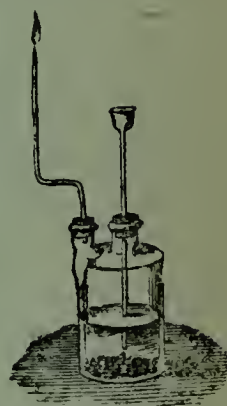
2251. Apparatus for exhibiting the Philosophical Candle, consisting of a 16 ounce gas bottle with a long jet of infusible Bohemian glass, at which to burn the hydrogen gas, Fig. 2251, 1s. 6d.

2252. Ditto, in the form of a Woulff's bottle, with a safety funnel to prevent an explosion in the event of the fusion of the jet, Fig. 2252, 2s. 6d.

2253. Long Gas Tubes, open at both ends, for producing musical sounds when held over the hydrogen gas flame, 20 inches long, 1 inch wide, 1s.



2251.



2252 .

Other sizes of tube may be used. The musical note changes with the size of the tube.

2254. Jet Tube of hard Bohemian Glass, with fine point for the above experiment, 10 or 12 inches by $\frac{1}{8}$ inch wide, 3d.

2255. Brass Tobacco Pipe, to use with the gas bladder, No. 2238 to blow soap bubbles with hydrogen gas, or oxyhydrogen gas, Fig. 2255, 2s.

2256. Bladder, Stopcock, and Tobacco Pipe, complete, Fig. 2256, 7s.

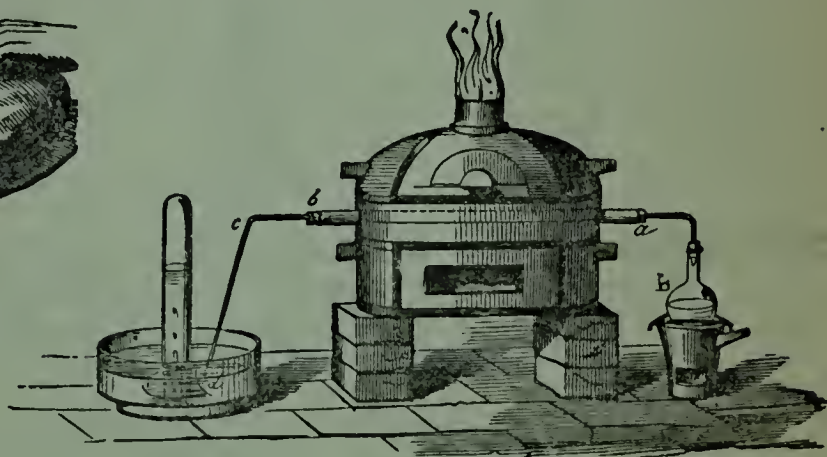
2257. Revolving Jet, T shape, for attaching to a receiver, No. 2238, to exhibit the combustion of coal gas, 3s.



2256.



2255.



2258.

2258. Apparatus for exposing substances to the action of gases at high temperatures, such as the production of hydrogen gas by the action of red-hot iron on steam; consisting of a French oblong fireclay furnace, 15 inches long, a Berlin porcelain tube, 27 inches long by $1\frac{1}{8}$ inch diameter, a 30 ounce flask for boiling water, with 3 gas-delivery tubes and connectors, Fig. 2258, ("Chemical Recreations," page 197), £2 2s.

Operations of this description can however be more conveniently performed by means of the Gas urnaces for tube operations, described at No. 1064.

2259. REDUCTION TUBES, for heating solids in gas, as in the decomposition of oxide of copper by hydrogen gas, of peroxide of barium by hydrogen gas, or of metallic sulphides by chlorine gas; strong tubes, $\frac{1}{3}$ inch bore, with bulbs in the middle, 1 inch in diameter, hard white Bohemian glass:—

2259. 12 inch tube, one bulb, straight, *e*, Fig. 2264, 6d.

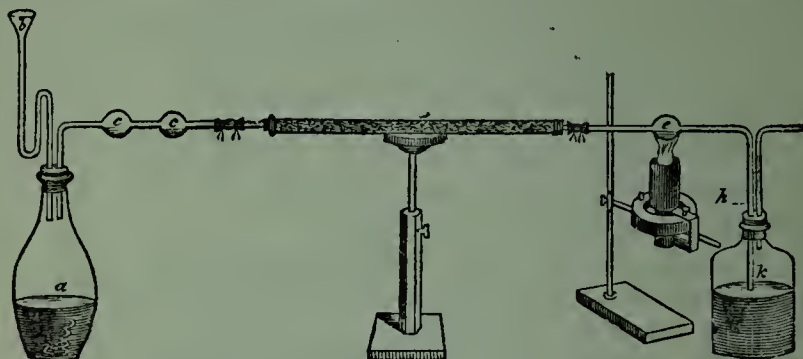
2260. 12 inch tube, two bulbs, straight, 8d.

2261. 12 inch tube, one inch bulb, bent at one end, *e*, Fig. 2263, 7d.

2262. 12 inch tube, two bulbs, bent at one end, *c, c*, Fig. 2263, 9d.

Figures 2263 and 2264 show the manner of fitting up such tubes for use.

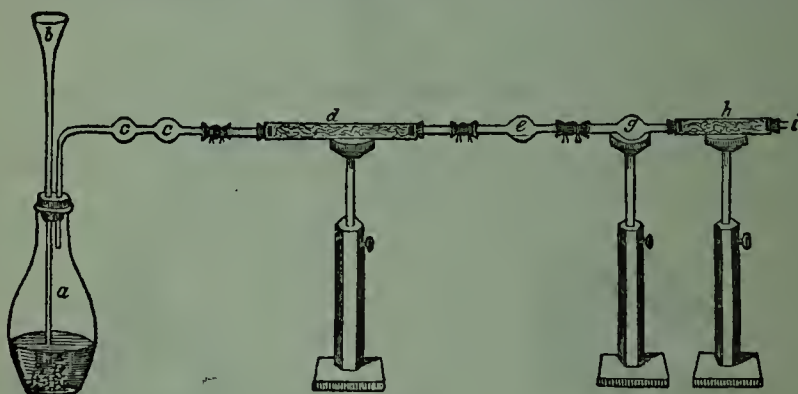
2263. Apparatus for the Conversion of Metallic Oxides into Chlorides, Fig. 2263.



2263.

2264. Apparatus for the Reduction of Metallic Oxides by Hydrogen Gas, Fig. 2264.

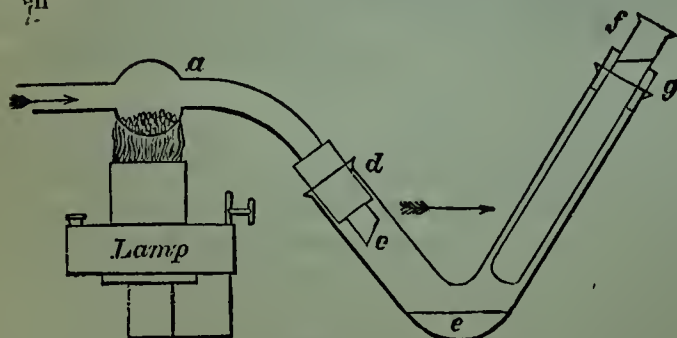
The parts of these sets of Apparatus have been priced in preceding section. Gas Bottles at No. 1962; Chloride of calcium tubes, No. 2047; Supports, No. 329-341; Spirit Lamps, No. 870.



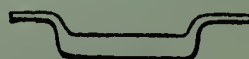
2264.

2265. Griffin's Apparatus for showing the Production of Water, by passing dry hydrogen gas over ignited oxide of copper, and the reduction of the oxide to the metallic state, consisting of three tubes, a reduction tube, and 2 condensing tubes, Fig. 2265 *a* to *g*, 2s. 6d.

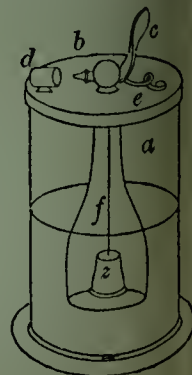
These
cases
are
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the
set



2265.



2266.



2267.

2266. Reduction Tubes, of the form shown by Fig. 2266, hard Bohemian glass, 8 to 10 inches long, 1s.
2267. HYDROGEN LAMPS, according to Döbereiner, for the instantaneous and constant production of light, by the action of spongy platinum upon hydrogen gas, neatly fitted up :—
2267. Plain glass jars, with brass cover, zinc, and platinum, complete, Fig. 2267, 7s. 6d.
2268. Coloured and Ornamental Jars, Fig. 2268, many patterns, from 10s. 6d., to 31s. 6d., each.
2269. Spongy Platinum, fixed in rings, for ditto, Fig. 2269, to fit the socket, *d*, Fig. 2267, 1s.
2270. Brass Jets for ditto, Fig. 2267*b*, 1s. each.
2271. Cast Zinc Cylinders for ditto, Fig. 2267*z*, 6d.

Directions for Use.—Put the apparatus together as shown in the figure. Fill the outer jar two-thirds full of a mixture of one part of sulphuric acid with four parts of water. Cover up the platinum, *d*, with paper, and open the stopcock, *c*, to let out the common air from the inner bell glass, *f*. Then let the stopcock close and allow the bell to fill with hydrogen gas. This must two or three times be allowed to escape while the platinum is covered : the hydrogen gas may after that be collected for use. The paper being taken from the platinum, the hydrogen on escaping from the stopcock first makes the platinum red hot, and then takes fire. But at first the gas requires to be lighted with paper to dry the platinum. Paper or wooden matches should be used to take a light from this lamp, as sulphur matches spoil the platinum.



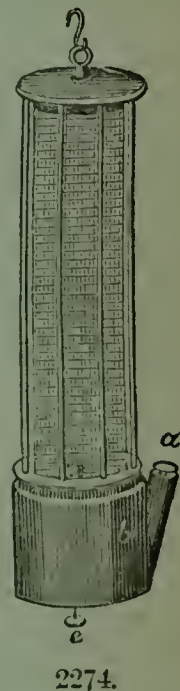
2272. Davy's Lamp without Flame, for perfuming rooms, or exhibiting the formation of Lampic acid ; consisting of a prepared ball of spongy platinum, connected to a cotton wick by a small glass wick holder, ready for insertion into a Spirit Lamp, Fig. 2272, 2s., in a box.

When the Lamp is to be used, the lamp is lighted in the ordinary manner, and when the platinum bulb is heated, the flame is blown out. Thereupon the bulb becomes red hot and continues so as long as the lamp contains any spirit. The light is extinguished by putting on the glass cap of the lamp, or by blowing upon it strongly. This apparatus can be used with any bottle that contains spirit.

2273. Davy's Lamp without Flame, consisting of a spirit lamp with a coil of platinum wire, form of Fig. 2273, 3s. 6d.

Davy's Safety Lamp for Coal Miner's Brass Lamps, iron gauze :—

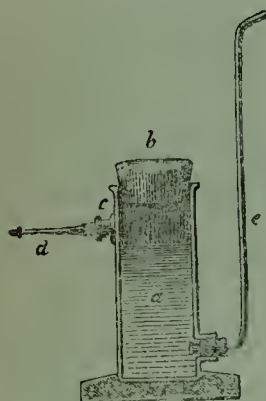
2274. Single Gauze, Fig. 2274, 6s.
2275. Double Gauze, 8s.
2276. Double Gauze, with glass cylinder round the flame for increase of light, 12s.
2277. Iron Wire Gauze, 50 meshes to the inch, for explaining the theory of the safety lamp, piece 8 inches square, 1s.
2278. Ditto, in larger quantities, 2s. 6d. per square foot.



OXYHYDROGEN BLOWPIPES.

2279. Tate's Apparatus for burning oxyhydrogen gas, consisting of a water cistern, with a gas pipe leading from the gas holder that contains the mixed gases, with a jet plugged with discs of wire gauze of 100 to the inch, and a cork safety valve, to render any possible explosion harmless, Fig. 2279, 8s.

2280. Hemming's Safety Jet, for the Oxyhydrogen Blowpipe, Fig. 2280, with a female screw at *b*, adapted to the stopcock, Fig. 303; the head *d*, is moveable, so that the jet *c*, can be placed immediately in the socket *a*, when a straight jet is required, 8s. 6d.
2281. Oxyhydrogen Blowpipe, form of Fig. 2281, with two stopcocks and union connectors for tubes to bring the two gases, a jet for the lime light, a massive jet marked *a*, to be used for the fusion of metals, &c. on charcoal, and a support for holding and turning the lime cylinder for the lime light, the whole mounted on a brass foot, as represented in the figure, 30s.
2282. Oxyhydrogen Blowpipe for the Lime Light, similar in principle to the last, but differently arranged, on a larger scale, and mounted on a tall and massive brass stand. with a sliding pillar to adjust the height of the light, as represented by Fig. 2282, price without the caoutchouc tubes, £2 2s.
2283. Oxyhydrogen Blowpipe for the Lime Light, similar to the last described, but mounted on a three-legged wooden stool, the stopcocks and pipes passing below the top of the stool, 31s. 6d.
2284. Daniel's Oxyhydrogen Blowpipe for the Lime Light, with Maugham's Jet with lime-holder, Fig. 2284, 20s.



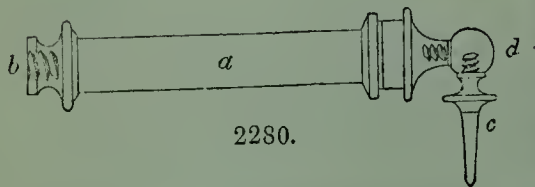
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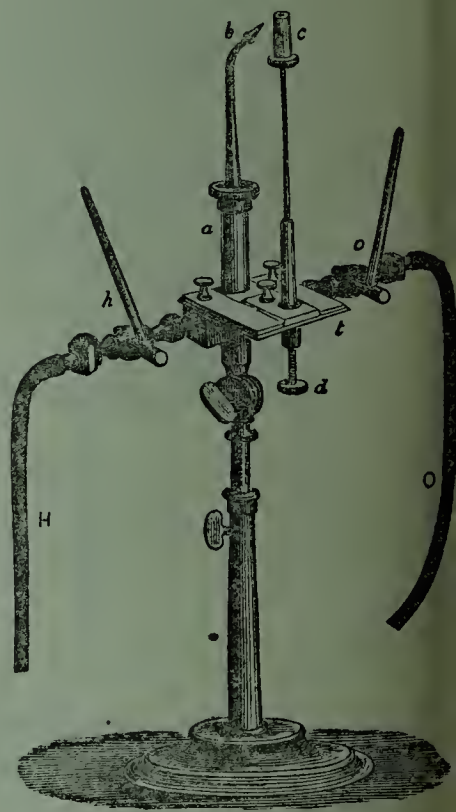
2281.



2284.



2280.



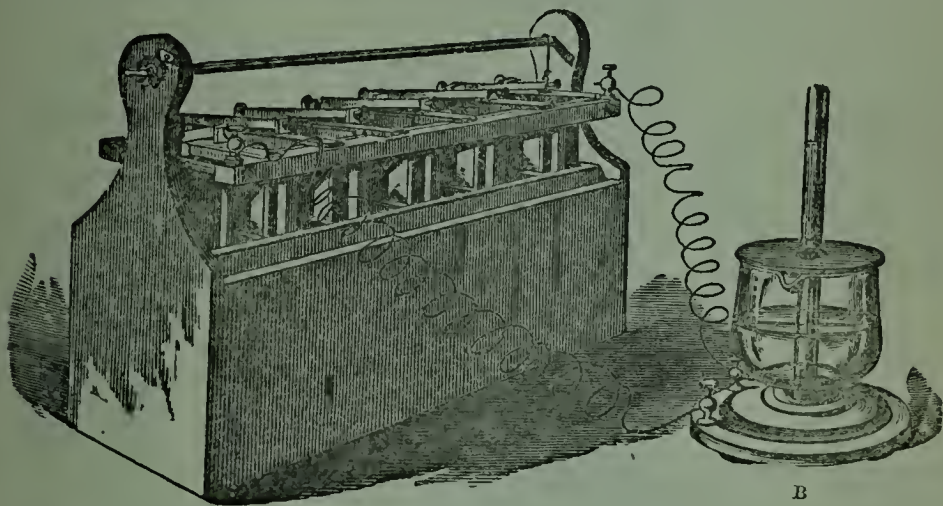
2282.

APPARATUS FOR EXHIBITING THE GALVANIC DECOMPOSITION OF WATER INTO OXYGEN AND HYDROGEN GASES.

The battery power must be at least six cells of Smee's, Grove's, or Bunsen's form of Galvanic Battery. The greater the number of cells used, the more rapidly is the decomposition of the water effected.

2285. SMEE'S GALVANIC BATTERY, consisting of six cells, each silver plate presenting 20 square inches of surface to the exciting fluid, arranged in mahogany frame, suspended by means of an iron rod and ratchet wheel over an incorrodible stoneware trough which contains the exciting fluid with binding screws and two sets of connecting bands, the shorter band being used to connect the zinc binding screw of one cell with the platinised silver binding screw of the next, when *intensity* is required; but if *quantity*

is needed, the short connectors are removed, and the two long ones used, one to connect all the zinc binding screws together, and the other to connect the screws in connection with the platinised-silver. The conveniences of this form are manifold; from the ease with which any desired power may be obtained by merely raising or depressing the battery frame; from the means at command of instantly setting it in action, and as readily stopping the current; from the facility of using *any one* or *all* the batteries, and the little trouble required to re-amalgamate or add new zinc plates. The voltaic energy of this arrangement is sufficient to yield 1 cubic inch of the mixed gases in 50 seconds; it will heat to redness 4 inches of platinum wire, fuse iron wire with facility, and empower a sufficiently strong electro-magnet to sustain many hundred weight. Price £3.



2285.

286. Zinc Plates for this Battery, per pair, 1s.

The fluid adapted for exciting all the forms and sizes of Smee's Battery is recommended by the inventor to be made by mixing together one part *by measure* of sulphuric acid (oil of vitriol), and seven parts of water, but for general purposes it has been found that one part of acid to ten of water is sufficiently powerful. Whatever strength is used, it is important that the acid be added slowly to the water, and that the mixture be made in a well-glazed vessel, *free from lead*, and in all cases allowed to cool before being used. Care must be taken in using this battery that no salt of lead, copper, or any other metal be dropped into the exciting liquid, nor any nitric acid added to increase the intensity.

287. GROVE'S PLATINUM BATTERY, SET OF EIGHT GLASS CELLS, with porous pots, amalgamated zines, and platinum plates, in a mahogany frame, forming the most powerful of all voltaic arrangements, well adapted for illustrating the brilliant experiments of Galvanism and Electro-magnetism, and to illustrate the applications of electricity to produce motive force. Price £5 5s.

Solutions to excite this Battery.—The outer glass cell is filled with sulphuric acid, diluted with seven times its bulk of water, and the inner cell with concentrated nitric acid, Fig. 2287.

288. Grove's Galvanic Battery, eight cells, with flat porcelain troughs, and a black wood frame, £3 10s.

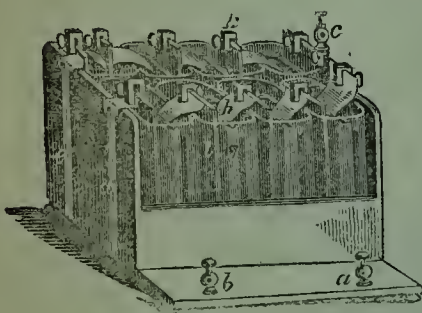
289. BUNSEN'S CHARCOAL BATTERY, in single cells, of the form of Fig. 2289; each consisting of a stout glass cell *a*, a zinc cylinder *b*, a porous pot *c*, a rectangular block of gas coke *d*, a binding screw *e*, and a slip of copper to form a connector *f*. *Three Sizes*:—

No.	Size of Glass Cell.	Size of Charcoal.		Price.
2289.	Quart.	8 in. long;	1 $\frac{3}{4}$ in. broad.	10s.
2290.	Pint.	6 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	8s. 6d.
2291.	Half-pint.	4 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	6s.

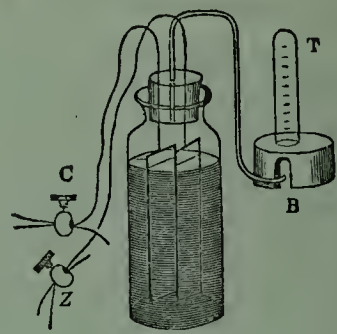
This battery is to be excited by concentrated nitric acid, put into the porous pot that contains the charcoal, and diluted sulphuric acid in the glass cylinder. For ordinary use, the diluted sulphuric acid may be made with one part of oil of vitriol with ten parts of water. When extra power is required, the water may be diminished to seven or eight parts. The mixture must be cold when put into the cells. The liquids on both sides of the porous pot must be kept at the same height. When the experiments are finished, the nitric acid must be thoroughly washed from the coke.

From six to ten cells of the Charcoal Battery are required for the decomposition of water. The greater the number of cells, the more rapidly is the gas produced. The electric light demands for its production thirty to fifty cells. With six to ten cells a small bright continuous point of light can be produced.

2292. Apparatus for the Decomposition of Water by Galvanism, and the delivery of the mixed gases into a gas holder; consisting of a large glass jar, 14 inches long, 2 inches wide, with large iron electrodes [to be used with a weak solution of caustic potash], two binding screws, a caoutchouc cap, and gas delivery tube, Fig. 2292, 7s.



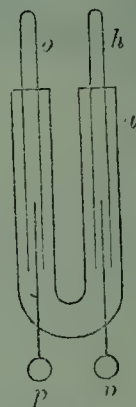
2287.



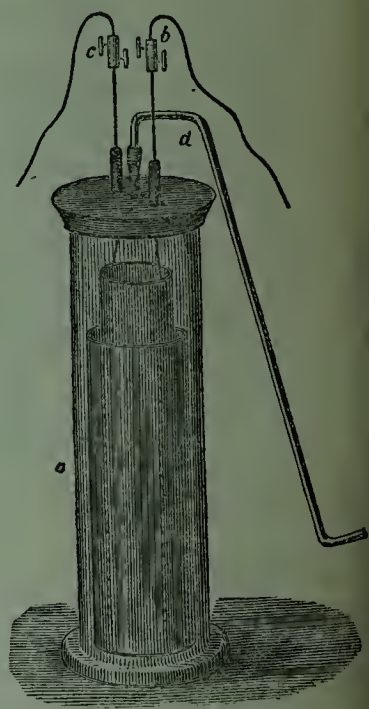
2293.

2293. Another, of smaller size, 20 ounces' capacity, form of Fig. 2293, with iron electrodes, to be used with a weak solution of caustic potash, price *without the parts marked B, T*, 4s.

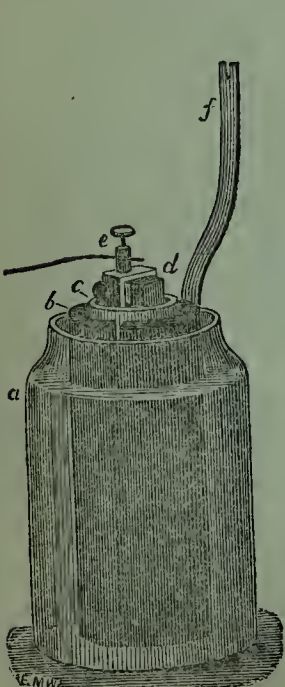
2294. Apparatus for decomposing water and collecting the two gases in separate tube, form of Fig. 2294, the gas tubes graduated, 3s. 6d.



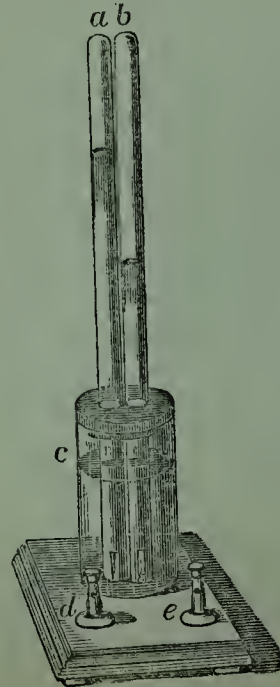
2294.



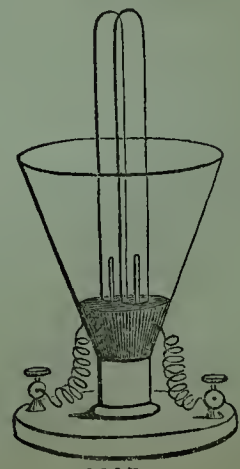
2292.



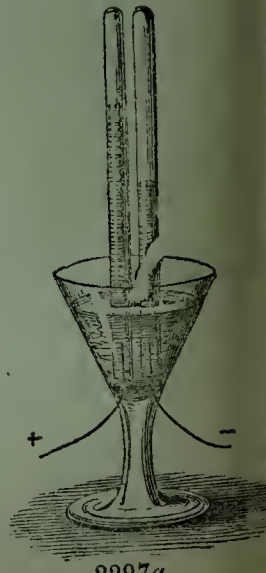
2289.



2295.



2297.



2297a.

2295. Another Apparatus, suitable for collecting larger quantities of the gases, Fig. 2295, 7s.

2296. Another form of the same Apparatus, B, Fig. 2285, 10s. 6d.

2297. Another, Fig. 2297, 10s. 6d.

2297a. „ Fig. 2297a, 7s.

2298. Another, Fig. 2298, 14s.

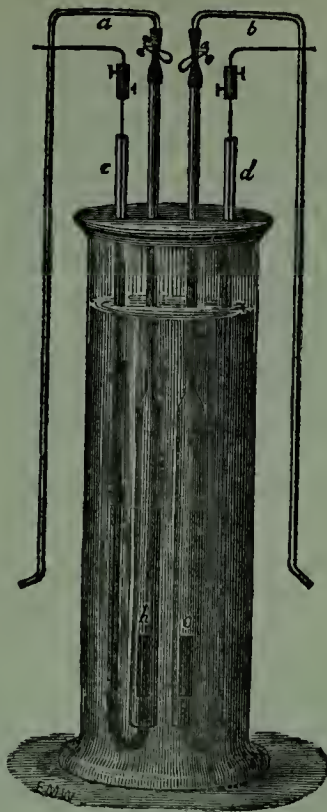
2299. „ Fig. 2299, 18s.

2300. FARADAY'S V TUBE for the decomposition of Neutral Salts, &c., fitted with Platinum Electrodes, conducting wires, Binding Screws, &c., Fig. 2300, 4s.

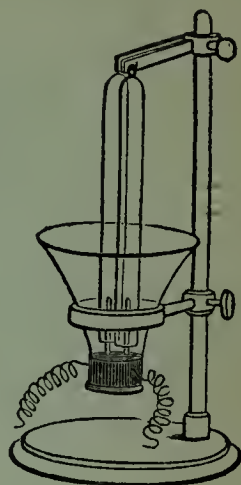
Fill the tube with a solution of the salt in water coloured with infusion of blue cabbage. Place the platinum plates and wires, as shown in the Figure, and connect the screws c and z to the wires of a battery containing at least 6 pairs of plates. The current passes through the fluid, and the dissolved salt is decomposed, the acid constituent passing to one pole, and the alkali to the other. The changes are rendered visible by the infusion turning red at the positive electrode and green at the negative.

2301. Platinum Wire, adapted for Galvanic purposes, where the heating power of a battery is to be tested, $\frac{1}{100}$ of an inch in diameter, 6d. per yard.

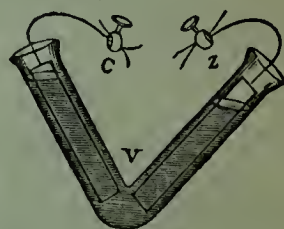
2302. Bunsen's Apparatus for decomposing water by galvanism, and preparing pure oxygen-hydrogen gas for analytical purposes, consisting of glass tube with platinum plates, and a bent gas delivery tube; mounted in a glass cylinder with a wooden cover and binding screws, Fig. 2302, 10s. 6d.



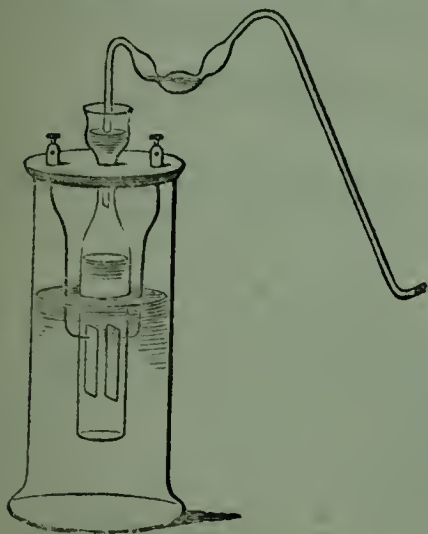
2298.



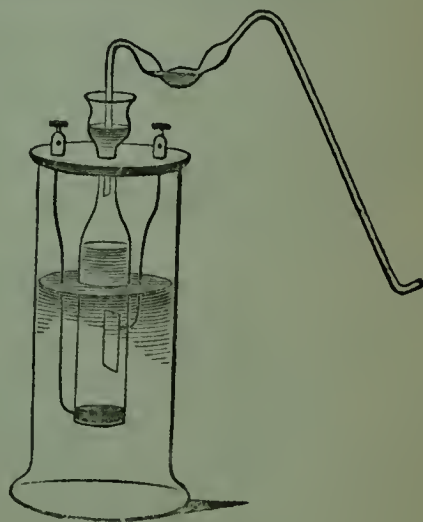
2299.



2300.



2302.



2303.

2302a. The Glass Tube Apparatus, without the glass cylinder, wood cover, and screws, 7s. 6d.

2303. Bunsen's Apparatus for preparing pure Hydrogen Gas by Galvanic Decomposition of Water, Fig. 2303, with glass cylinder, wooden cover, and binding screws, 10s. 6d.

2303a. The Glass-tube Apparatus, without the cylinder, wooden cover, and binding screws, 7s. 6d.

The instruments, No. 2302 and 2303, are described in Bunsen and Roscoe's *Gasometry*, pages 63-68; but Figs. 2302 and 2303 show some improvements in the style of mounting. The detonating gas is produced by passing the voltaic current through diluted sulphuric acid, strength 1 to 10, the power being that of 4 Bunsen's carbon batteries, Fig. 2289. The bulbs in the leading tube contain strong oil of vitriol. The outer cylinder is partly filled with alcohol to prevent the heating of the wires by the voltaic current.

In Fig. 2303, the positive wire passes through the glass into an amalgam of zinc and mercury. The battery power is that of 2 or 3 carbon batteries. Free hydrogen is given off, and the liquor in the tube soon becomes saturated with sulphate of zinc, which must be removed after each operation.



2304.

2304. Another Apparatus for Preparing Pure Hydrogen Gas for eudiometrical use, Fig. 2304, 6s.

The use of this apparatus is described in *Chemical Recreations*, page 228. It is a modification of 2303.

2305. Sir H. Davy's Apparatus for explaining the composition of water, consisting of a glass tube, with a pair of platinum plates, for the galvanic decomposition of water, and a pair of wires for recomposing the water by an electric spark, without removing the gases into another vessel, 10s. 6d.

2306. Glass Tubes for Collecting the Oxygen and Hydrogen Gases, separated by the decomposition of water, graduated into cubic centimeters, small size, pair, 1s. 6d.

2307. Ditto, 20 or 25 centimeters in length, graduated into cubic centimeters, pair, 5s.

2308. Graduated Tubes, in which to collect and measure the gases, produced by the decomposition of water, Fig. 2308, the graduation in decimals of cubic inches:—

- | | | | | |
|----|------|----------------|------------------------------|---------|
| a. | Tube | 8 inches long, | $\frac{3}{4}$ inch diameter, | 3s. |
| b. | „ | 10 „ | $\frac{7}{8}$ „ | 3s. 6d. |

2309. Mounted Bell Jar for collecting the gas produced by the decomposition of water, Fig. 2309, 4s.



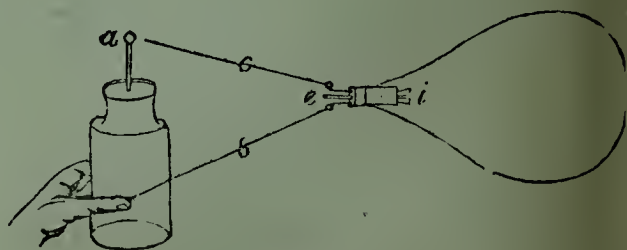
2308.



2309.



2310.



2311.

2310. APPARATUS for EXPLODING MIXTURES of OXYHYDROGEN GAS, namely, two volumes of hydrogen with one volume of oxygen:—

2310. Stout German Glass Detonating Bottle, with foot and ground stopper, Fig. 2310, 2s.

The gas is fired by drawing the stopper and applying a light at the neck of the bottle.

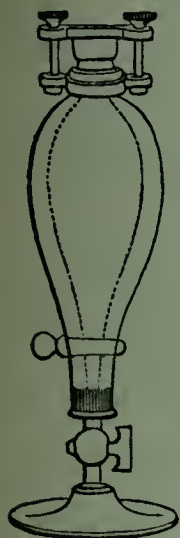
2311. Large Bladder, fitted with glass tube, for use in filling the bladder with gas, and two Wires for conveying an electric spark for firing the gas, Fig. 2311, 2s.

This apparatus, when ready for exploding, should be attached to two wires, *b* and *c*, which should be at least 20 feet long, to keep the bladder a safe distance from the operator, who is to use the electrical apparatus. When the bladder is large it is advisable to expose it in the open air for explosion, because the concussion is unpleasantly violent in a room.

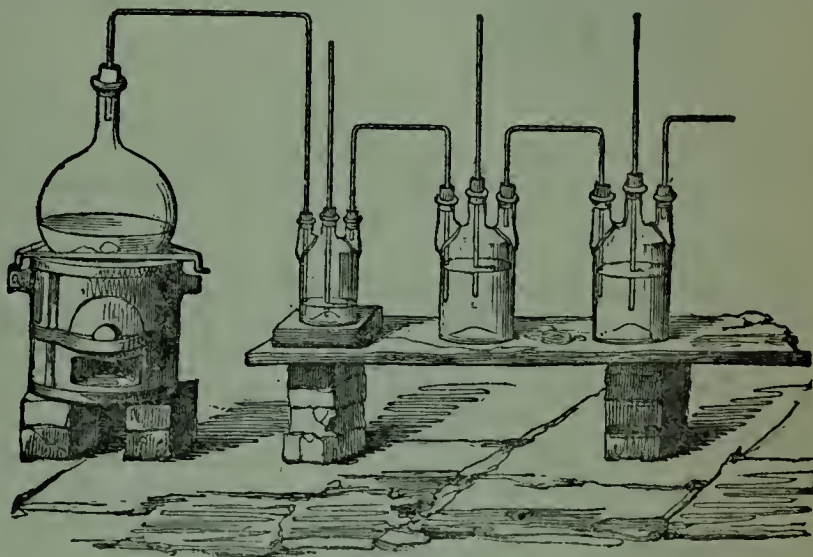
2314. Cavendish's Eudiometer, for showing the production of water by the combination of oxygen and hydrogen gases, when the mixture is exploded by the electric spark, Fig. 2314, 35s.

See *Chemical Recreations*, page 217.

The wires by which the spark is conveyed, pass through the glass stopper, but are not shown in this Figure.



2314.



2318.

2315. Apparatus for exhibiting the sudden and total absorption and condensation of certain gases (ammonia and hydrochloric acid) by water. Fig. 2315, *a* and *b*.

The glass cylinder Fig. 2315*a* is priced at No. 2122. The flask, Fig. 2315*b*, at No. 1405. The glass pans at Nos. 1542 and 1780.



2315*a*.

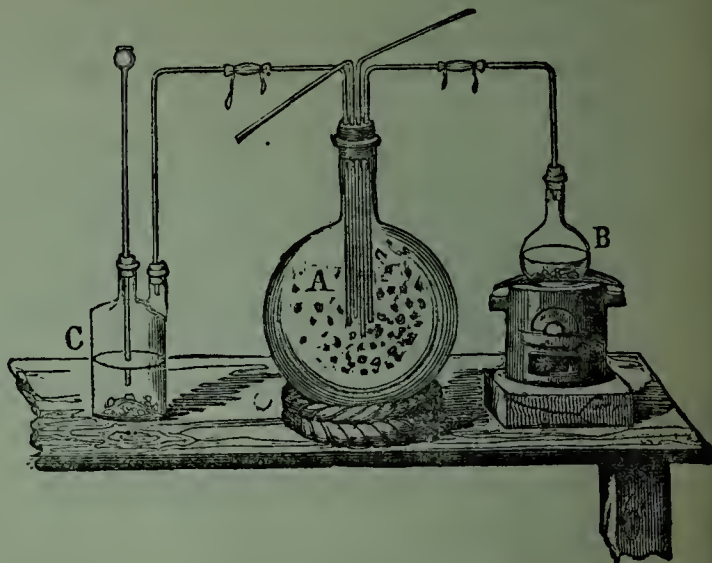


2317.

2316. Apparatus for the Distillation of Ammonia from Bones, of gas from coal, and of acetic acid from oak wood, as class experiments, processes described in "Chemical Recreations," pages 326, 556, and 433, apparatus represented in this book by Fig. 330, page 32, consisting of a tube retort, a bent tube receiver, and a gas delivery tube, 2s.

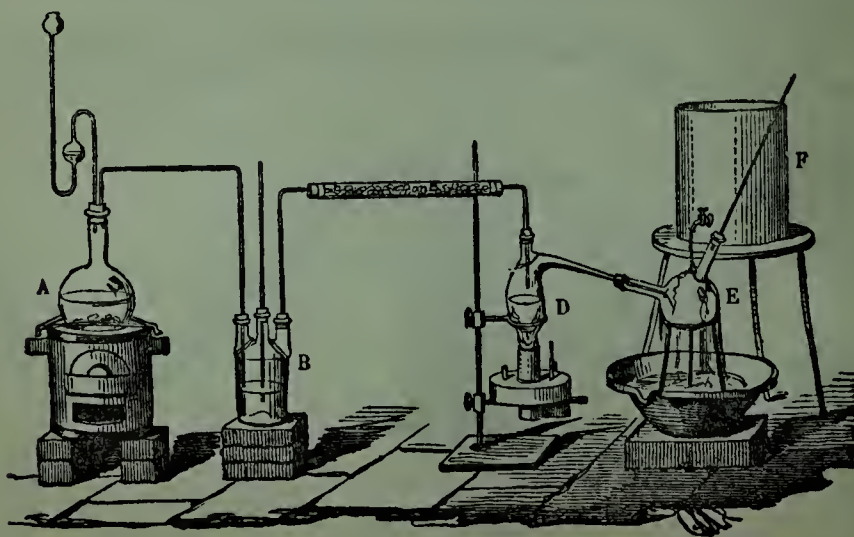


2315b.



2319.

2317. Glass Tube Apparatus for the Preparation and Purification of Coal Gas, as a class experiment. See "Chemical Recreations," page 557, represented by Fig. 2317, including a pint jar, 4s.
2318. Regnault's Apparatus for the Preparation of Hydrochloric Acid ("Chemical Recreations," page 673), consisting of a French fire-clay furnace, $6\frac{1}{2}$ inches diameter, with one door, a flask (ballon), 40 ounce capacity, two Woulff's bottles with 3 necks, of 50 ounce capacity, one Woulff's bottle with 3 necks, of 20 ounce capacity, 10 glass bent tubes, with corks, and caoutchouc connectors, Fig. 2318, 18s.
2319. Apparatus for Explaining the Production of Sulphuric Acid by the action of nitric oxide gas, and sulphurous acid gas on steam, "Chemical Recreations," page 600, consisting of a glass globe, 12 inches diameter, a 30-ounce flask fitted for sulphurous acid, and a 20-ounce Woulff's bottle, with 2 necks fitted with acid funnel, for nitric oxide, with four connecting tubes, a clay support for the globe, and a fire-clay furnace, with one iron ring, Fig. 2319 20s.



2320.

2320. Regnault's Apparatus for the Preparation of Terehloride of Phosphorus, Fig. 2320.

This figure is given as an example of a very complex set of apparatus for the distillation of a gas. The operation is described in "Chemical Reereations," page 687.

All the parts of this apparatus have been described in preceding sections. The furnae at No. 803; the gas bottle at No. 2034; the Woulff's washing bottle at No. 2038; the chloride of calcium tube at No. 2053; the spirit lamp at No. 870; the tubulated retort at No. 1809; the two necked receiver at No. 1849; the conical pan at No. 1540; the water bottle at No. 246; the stools at No. 406; and the blocks at No. 393.

GAS APPARATUS FOR ANALYTICAL PROCESSES.

2324. The observations that were made at No. 2223, the commencement of the last sub-division, might be repeated in this place; since the articles about to be described are not presented as a *set*, or a *collection* of apparatus for the Analysis of Gases, but are merely a few articles of that character which did not properly fall into any of the preceding sections. A complete collection of analytical apparatus for gases would include a great number of articles that have been already described, in addition to what are grouped here.

GRADUATED GAS TUBES AND JARS.

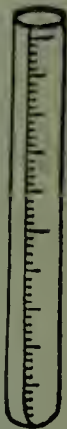
2325. GLASS GAS RECEIVERS, so graduated as to show the WEIGHT of a GAS from the MEASURE, as explained in Griffin's "Chemical Recreations," page 141.

a. Gas Tube, 11 inches long, 3 inches diameter, contains 1 grain of pure hydrogen gas at 60° Fahr. Bar, 30 inches, and divided into 100 parts, each equal to $\frac{1}{100}$ grain, 4s.

b. Gas Tube 10 inches long, $\frac{7}{8}$ inch diameter, contains $\frac{1}{10}$ th grain of hydrogen, graduated into 100 parts, each = $\frac{1}{1000}$ grain, 3s.

c. Gas Tube, 8 inches long, $\frac{3}{8}$ inch diameter, contains $\frac{1}{10}$ th grain of hydrogen, graduated into 100 parts, each = $\frac{1}{1000}$ grain of hydrogen, 3s.

The weight of any gas measured in these vessels is found by multiplying the measure of the gas by its specific gravity, taking the latter from a table in which hydrogen is reckoned at unity. See "Chemical Reereations," page 141, or "The Radial Theory in Chemistry," page 50, for a table of all known gases and vapours.



2326.

2326. Glass Tubes graduated into decimals of the English cubic inch:—

containing 1 C. In. in 100ths, 3s.				7. containing 8 or 9 C. In. in 10ths, 5s.			
"	1½	"	50ths, 3s. 6d.	8.	"	10	" 10ths, 5s.
"	2	"	50ths, 3s. 6d.	9.	"	16	" 10ths, 7s. 6d.
"	2½	"	10ths, 2s. 6d.	10.	"	36 to 39	" 5ths, 9s.
"	2¾	"	50ths, 4s.	11.	"	50 to 55	" 5ths, 9s.
"	4	"	20ths, 5s.				

2327. Cylindrical Jars, with foot and flange, graduated into English cubic inches, German glass.

3 cubic inches, 1s. 3d.	10 cubic inches, 2s. 9d.	24 cubic inches, 5s. 6d.
4 " 1s. 6d.	12 " 3s. 6d.	30 " 6s.
6 " 2s.	16 " 4s. 6d.	40 " 7s.
8 " 2s. 3d.	20 " 5s.	50 " 8s.

2328. BELL GAS RECEIVERS, with necks, German glass, graduated into cubic inches.

50 cubic inches,	250 cubic inches,
100 " "	300 " "
150 " "	400 " "
200 " "	500 " "

2329. Glass Cylinder, form of Fig. 2329, about 12 inches long, 2 inches wide, contents 30 cubic inches, graduated into cubic inches, 2s. 6d.



2330. Glass Cylinder, with funnel-shaped mouth, 8 inches long, 2 inches diameter across the middle, 3 inches across the funnel mouth, contents about 50 cubic inches, graduated into $\frac{1}{2}$ cubic inches, 6s. 2329.

2331. Glass Tubes, graduated into cubic centimeters.

25 c. c. in $\frac{1}{8}$ c. c. 2s.	150 c. in $\frac{1}{4}$ c. c. 4s.
50 c. c. in $\frac{1}{8}$ c. c. 2s. 6d.	200 c. in $\frac{1}{4}$ c. c. 4s. 6d.
100 c. c. in $\frac{1}{2}$ c. c. 3s. 6d.	

2332. Cylindrical Jars, with foot and flange, graduated into centimeter cubes, German glass.

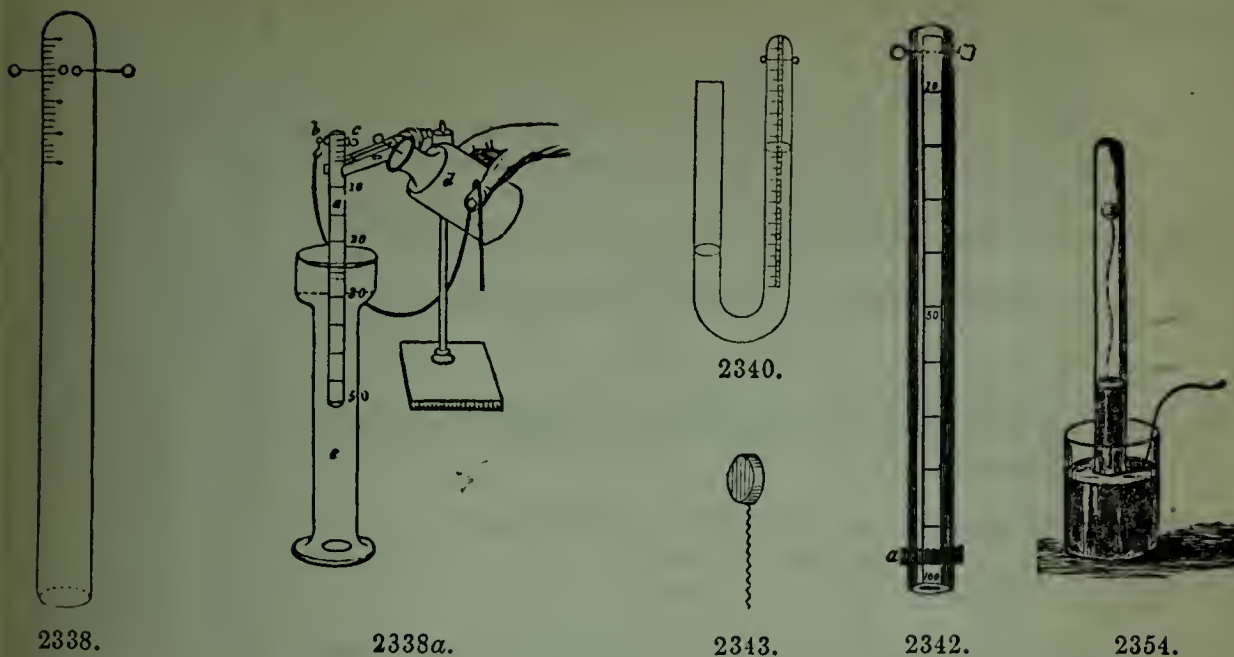
5 cent. cubes, 9d.	150 cent. cubes, 2s. 9d.	500 cent. cubes, 4s.
10 " 1s.	200 " 3s.	600 " 4s. 9d.
25 " 1s. 6d.	250 " 3s. 3d.	700 " 5s. 6d.
50 " 1s. 9d.	300 " 3s. 6d.	800 " 6s. 6d.
75 " 2s.	400 " 3s. 9d.	1000 " 8s.
100 " 2s. 6d.		

2333. Cylindrical Jars, with foot and flange graduated into centimeter cubes, with figures reading upwards as well as downwards, German glass:—

5 c. cubes, 10d.	150 c. cubes, 3s.	500 c. cubes, 5s.
10 " 1s. 2d.	200 " 3s. 4d.	600 " 5s. 6d.
25 " 1s. 9d.	250 " 3s. 8d.	700 " 6s. 6d.
50 " 2s. 2d.	300 " 4s.	800 " 7s. 6d.
100 " 2s. 9d.	400 " 4s. 6d.	1000 " 9s.

2334. BELL GLASS RECEIVERS, with necks, German glass, graduated into cubic centimeters.

1000 centimeter cubes.	6000 centimeter cubes.
2000 " "	8000 " "
3000 " "	10000 " "
5000 " "	



EUDIOMETERS.

For the analysis of atmospheric air, and of mixtures that contain oxygen or hydrogen, or other gases that are decomposed by combustion with either of these, and for explaining the composition of water.

2338. Volta's Eudiometer, about 16 to 18 inches long, and $\frac{5}{8}$ -inch wide, Fig. 2338 or Fig. 2338 *a*, graduated the entire length, the upper part closely.

- a*. 3 cubic inches, graduated to show 100ths of a cubic inch, 4s. 6d.
- b*. 60 centimeter tubes, graduated to show $\frac{1}{4}$ or $\frac{1}{10}$ c. c., 4s. 6d.

2339. Japanned Tinplate Case for Volta's Eudiometer, 1s.

2340. Ure's Syphon Eudiometer, form of Fig. 2340.

- a*. 2 cubic inches, graduated to show $\frac{1}{10}$ cubic inch, 6s.
- b*. 50 centimeter tubes, graduated to show $\frac{1}{4}$ or $\frac{1}{10}$ c. c., 6s.

2341. Japanned Tinplate Box to hold Ure's Eudiometer, 1s. 6d.

2342. Mitscherlich's Eudiometer, very stout glass tube with stopper, form of Fig. 2342; length about 13 inches, external diameter, $1\frac{3}{4}$ -inch; contents 2 cubic inches, graduated to show $\frac{1}{10}$ c. c., 16s.

The stopper is used to prevent loss of gas while the expansion occasioned by the explosion takes place. The glass is made extremely thick to enable it to withstand the explosion; but the difficulty preparing and annealing the instrument is such that it is rare to find one that remains sound for any length of time. It sometimes happens that after an instrument has been made for months, it suddenly explodes without being touched.

2343. Eudiometer Balls, Fig. 2343, per dozen, 4s.

These are made of a mixture of clay and spongy platinum. When passed up by means of an iron wire into a mixture of oxygen and hydrogen gases confined over mercury, as represented by Fig. 2354, the ball causes the gases to combine gradually without explosion. See "Chemical Recreations," page 215.

Among the reagents that are employed for the absorption of gases in this manner are the following :—

Absorbing Reagents

Peroxide of Manganese.
Caustic Potash.
Phosphorus.
Coke saturated with a mixture of
anhydrous and fuming sulphuric
acid.
Chloride of Calcium.
Phosphate of Soda Crystallised.
Borax Crystallised.

Gases to be Absorbed.

Sulphurous Acid.
Carbonic Acid.
Oxygen.
Olefiant Gas.
Vaporized solid and liquid Hydro-
carbons.
Water.
Chlorine.
Chlorine.

See Bunsen and Roscoe's Gasometry, page 52. Handwörterbuch der Chemie, Bd. II. S. 1062, section Eudiometer, where a special article is given on the analysis of coal gas. Rose's analytischen Chemie, Bd. II. S. 916. Miller's Elements of Chemistry, vol. II. page 661. Regnault, Cours Élémentaire de Chimie, tome IV. page 74.

GAS PIPETTES.

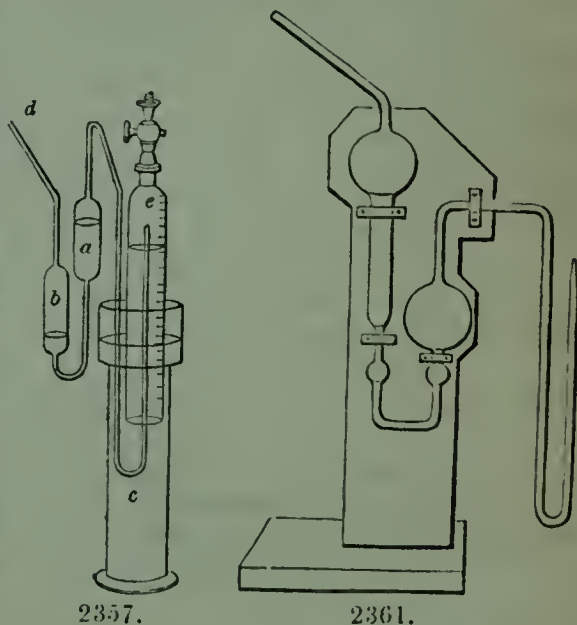
2357. GAS PIPETTE, ETTLING'S, for transferring a portion of Gas from a long narrow gas receiver into another receiver, without inverting the long receiver, Fig. 2357, *small size pipette*, each bulb 3 by $\frac{3}{4}$ inch, the outer syphon tube 9 inches long, 1s. 3d.
2358. Ditto, *large size pipette*, each bulb 3 $\frac{1}{2}$ by 1 inch, the outer syphon tube 18 inches long, 1s. 6d.
2359. Ditto, a packing case, containing one pipette of each size, 3s. 6d.

2360. This instrument is made according to the pattern exhibited by Fig. 2357. It will, perhaps, be acceptable to all chemists who work much with pneumatic apparatus. It renders large pneumatic troughs unnecessary, and presents the advantage that any given quantity of gas can, by means of it, be taken from a bell-glass or graduated tube, standing within a cylinder, and transferred to another vessel, without its being necessary to remove the bell-glass from the cylinder for the purpose of evacuating the gas. And this transference can be effected with the help of very little liquid.

In using the pipette, the cylinder *a* is first to be filled with water (or mercury) by dipping the branch into the liquid, and sucking at the end *d*. The point *e* is then to be introduced into the tube from which the gas is to be taken; and by sucking again at the point *d*, the liquid is removed from the cylinder *a* into the cylinder *b*, while its place is filled by gas from the tube. The apparatus is then pressed downwards until the point *e* dips into the liquid contained in the cylinder (water or mercury), upon which some of the liquid enters into branch *c*, and prevents the escape of the gas.

The gas is removable from the pipette by blowing into the end *d*; and if the orifice at the end *e* is very small, and the gas is blown out gently, any determinate quantity of it can be thus transferred to an eudiometer or other vessel.

When the liquid that confines the gas is mercury, it is then somewhat difficult to blow out the gas in consequence of the weight of the column of mercury. This difficulty can be overcome by good management.



2361. Doyere's Gas Pipette, described by Gerhardt, *Traité de Chimie Organique*, I, 104, Fig. 2361, without stand, 2s. 6d.
2362. Ditto, mounted on a wooden stand with brass bands, Fig. 2361, 9s.
2363. Miller's Gas Pipette (see Miller's *Elements of Chemistry*, II., 477), with two iron stopcocks, mounted on a board, 14s.
2364. Ditto, with caoutchouc tubes and brass lever pinchcocks, instead of the iron stopcocks, 9s.

INSTRUMENTS FOR GAS ANALYSIS USED BY BUNSEN.

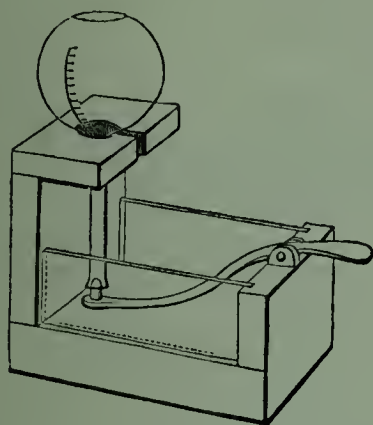
2365. Large Porcelain Tubes, glazed inside and outside, by the rubbing of which with silk and amalgam, electricity is produced sufficient to charge a small Leyden jar for giving the spark in eudiometrical experiments. (See Bunsen's Gasometry, page 46.) Thuringian porcelain, 24 inches long 2 inches wide, 4s. 6d.
2366. Ditto, Berlin porcelain, 35 by $1\frac{1}{2}$ inches, 16s.
2367. Small Leyden Jar, $2\frac{1}{2}$ inches high, $1\frac{1}{2}$ inch wide, fitted for this operation, 2s.
2368. Ditto, coated outside with platinum, 6s.
Bunsen's Apparatus for preparing pure hydrogen and oxyhydrogen gas for use in eudiometrical operations, see Nos. 2302 and 2303.
Bunsen's Gas Holder for Eudiometrical Operations, see No. 2177.
2369. Bunsen's Steam Apparatus, for converting the water produced by an explosion in the Eudiometer into vapour, and measuring it in that state. (See Bunsen's Gasometry, page 47.) *Price, without support and gas burner*, 33s.
2370. Bunsen's Apparatus for Graduating Glass Tubes, with scale of millimetres &c., complete. (See Bunsen's Gasometry, page 26, Fig. 21.) £2 12s. 6d.
2371. Bunsen's Absorptiometer, for determining the laws of the absorption of gases in liquids. (See Bunsen's Gasometry, page 138, Fig. 43.) £7.
2372. Bunsen's Apparatus for determining the specific gravity of gases by effusion. Fig. 2372. (See Bunsen and Roscoe's Gasometry, Fig. 40, page 122.) 12s. 6d.
2373. Bunsen's Apparatus for measuring the volume of a gas, with a view to the determination of its specific gravity, consisting of a graduated flask, contains 200 to 300 c. cubes, and a chloride of calcium desiccating tube, Fig. 2374. (See Bunsen and Roscoe's Gasometry, Figs. 38 and 39.) 6s.
2374. Ditto, a Pneumatic Trough for use with the preceding apparatus; mahogany with plate glass sides, Fig. 2374, 20s.
2375. Copper Cone and Three Copper Collars, for grinding the necks of flasks under $\frac{1}{4}$ inch bore, and fitting glass stoppers to them by grinding with emery and turpentine; to form such apparatus as No. 2373. (See instructions in Bunsen's Gasometry, page 118.) *The set*, 2s. 6d.
2376. Blowpipe Lamp, to attach to a blowpipe, for use in sealing up the ends of glass tubes and the narrow necks of flasks that contain gases, mineral waters &c., 2s. 6d.

The use is explained in Bunsen and Roscoe's Gasometry, page 3. In order to have both hands free during the fusion of the neck of a vessel, a mouth blowpipe is employed, and a lamp, containing about $\frac{1}{10}$ ounce of oil, is connected with the blowpipe by means of a wire and a small ring. By bending the wire, it is easy to give the flame the requisite form and length. A cork is fixed in the upper end of the blowpipe, and is to be placed between the teeth, by which means the blowpipe can be held in such positions as to throw the flame in any desired direction, horizontal, vertical, or transverse.

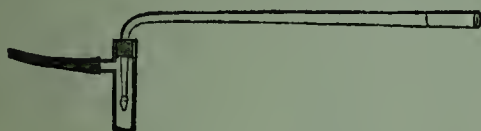
2377. Mouth Blowpipe, attached to a Gas Burner, for the same use, Fig. 2377, 3s.
 2378. Bunsen's Syphon Barometer, form of Fig. 2378, the tube graduated on both branches into millimetres, diameter of the tube such as to take about 12 ounces of mercury, filled and boiled, 15s.
 2379. The Graduated Barometer Tube, without mercury, 8s.
 2380. Support for the Barometer, consisting of an iron clamp, rod and foot, as represented in Fig. 2378, 6s. 6d.
 2381. Thermometer for insertion in the lower limb of the Barometer, 4s.
 2382. Plummet to attach to a thread, and suspend near the Barometer, &c., to secure their being placed in a vertical position. (See Bunsen's Gasometry, page 22.) 1s.
 2383. Cathetometer, form of Fig. 2383, the telescope with micrometer, for use in observing the height of the mercury in Barometers, Gas Tubes, Eudiometers, &c., without approaching near them, £3 10s.



2372



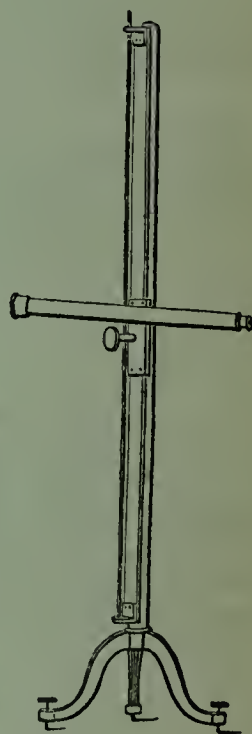
2374.



2377.



2378.

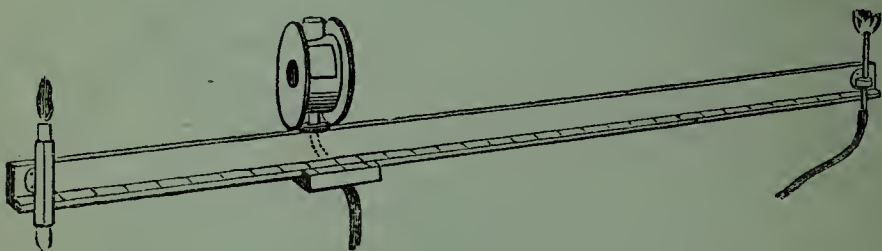


2383.

APPARATUS USED IN THE TECHNICAL ANALYSIS OF COAL-GAS.

2384. Graduated Bottle, 12 inches by $3\frac{1}{2}$, with a stopper at top and a neck at the side near the bottom, graduated into 100 parts, 10s. 6d.
2385. Graduated Tube, 30 inches by $\frac{3}{4}$ inch, form of Cooper's Gas Receiver, with a bulb at top and the mouth stoppered, graduated into 100 parts, 9s.
2386. Pair of Cooper's Gas Receivers, 10 or 12 inches by $\frac{3}{4}$ inch, graduated into cubic inches, with a porcelain tray, 6 by 5 inches, and a mahogany stand, 10 by 12 inches, with two jointed brass clamps and 16 inch rods to support the tubes, 25s.
2387. Cooper's Tube, 30 inches long, and about $\frac{5}{8}$ inch diameter, the contents graduated into 100 parts, and each part into 5ths; in all 500 divisions, 9s.
2388. Sheet Iron Water Trough, for use with ditto, 3 feet high, $4\frac{1}{2}$ inches wide, with glass top.
2389. BUNSEN'S PHOTOMETER, for comparing and measuring the power of gas-lights, 50s.

2390. Bunsen's Photometer is represented by Fig. 2389: the slide, provided with a graduated scale, is about 4 feet long. At the left-hand end is a support (omitted in the figure) and a clamp for the normal candle. At the right-hand end is a clamp for the gas-burner that is to be tried. The cylindrical closed chamber, represented on the slide, moves from end to end upon it. It contains a gas burner connected with a flexible pipe, by which it can be fed. On one side of the chamber is a disc of paper made translucent by stearine, except a circular piece in the middle. The chamber revolves upon its axis, so that the paper disc can be presented either to the normal candle, or to the light that is to be tried. The operation of trial is as follows:—The normal candle is allowed to burn ten minutes, until it is in proper condition, and at a height corresponding to the centre of the paper disc. The gas-light in the chamber is then so regulated that, the candle-light playing at the same time on the disc, no difference can be seen between the *greased* and *ungreased* portions of the paper. The chamber is then turned round 180° , so as to place the paper disc opposite the gas-light that is to be tried, and the chamber is to be pushed along the slide towards the gas-light, until the different parts of the paper again become undistinguishable. If, then, the distance from the paper of the gas-light and of the normal candle is the same, which is to be observed on the engraved scale attached to the slide, the gas-light has the illuminating power of one standard candle. If the distance of the gas-light is twice that of the normal candle, the illuminating power of the gas-light is four times that of the candle, and so on.



2389.

Application of Chemical Tests.

2400. TEST TUBES, OF THE BEST THIN
HARD WHITE GERMAN GLASS,
closed and properly rounded
at one end, and bordered at
the mouth; neatly finished
and well annealed, Fig. 2400.



2400.

PRICE PER DOZEN.

LENGTH of TUBES, in INCHES.	DIAMETER of the TUBES across the middle, in INCHES.								
	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$
2 inches	4d.	4d.	5d.	6d.	7d.	—	—	—	—
3 „	4d.	5d.	6d.	7d.	9d.	10d.	1s. —	—	—
4 „	6d.	7d.	8d.	10d.	1s. —	1s. 1d.	1s. 2d.	—	—
5 „	8d.	8d.	10d.	1s. —	1s. 1d.	1s. 3d.	1s. 4d.	1s. 7d.	—
6 „	—	—	1s. —	1s. 1d.	1s. 2d.	1s. 4d.	1s. 6d.	1s. 9d.	2s. —
7 „	—	—	1s. 2d.	1s. 3d.	1s. 4d.	1s. 6d.	1s. 9d.	2s. —	2s. 6d.
8 „	—	—	—	—	1s. 6d.	1s. 8d.	1s. 10d.	2s. 6d.	3s. —

*Test Tubes of smaller sizes than the above are described under the head of
Blowpipe Apparatus.*

2401. Brush for cleaning Test Tubes,
handle of galvanized iron
wire, Fig. 2401, 3d.



2402. Ditto, for very narrow tubes, 2d.

2401

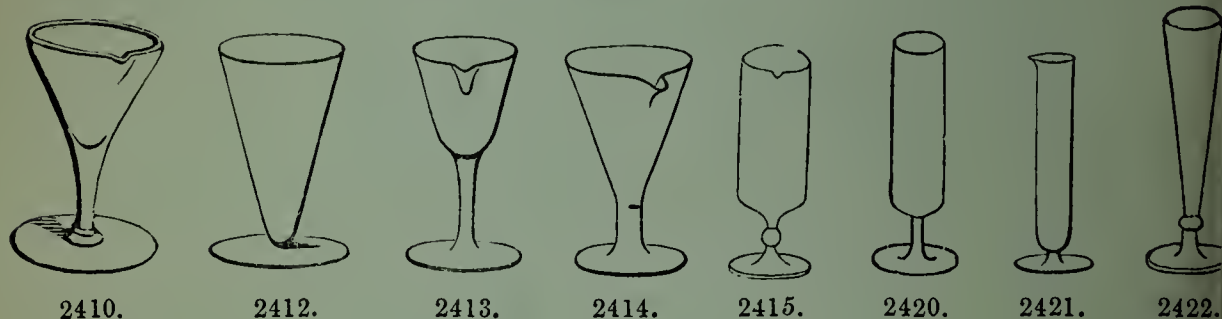
COLLECTIONS OR ASSORTMENTS OF TEST TUBES.

2403. Collection of 42 Testing and Boiling Tubes, 4s.
 12 each of 5 by $\frac{1}{2}$ and 6 by $\frac{3}{4}$ inch.
 6 each of 3 by $\frac{3}{4}$, 6 by 1, and 6 by $1\frac{1}{4}$ inch.
2404. Collection of 60 Testing and Boiling Tubes, 6s.
 12 each of 5 by $\frac{1}{2}$, 5 by $\frac{5}{8}$, 5 by $\frac{3}{4}$, and 6 by 1 inch.
 6 each of 6 by $\frac{3}{4}$, and 7 by $1\frac{1}{4}$ inch.
2405. Collection of 120 Testing and Boiling Tubes, 10s.:
 12 each of 2 by $\frac{1}{4}$, 3 by $\frac{3}{8}$, 3 by 1, and 4 by $\frac{1}{2}$ inch.
 12 each of 5 by $\frac{1}{2}$, 5 by $\frac{5}{8}$, 5 by $\frac{3}{4}$, and 6 by 1 inch.
 6 each of 6 by $\frac{3}{4}$, 6 by $1\frac{1}{2}$, 7 by $\frac{3}{4}$, and 7 by $1\frac{1}{4}$ inch.

TEST TUBES, IN NESTS, in round pasteboard cases, suitable for travelling sets of apparatus.

2406. Nest of 3 tubes, from 3 inch by $\frac{3}{8}$ inch, to 5 inch by $\frac{3}{4}$ inch, 6d.
 2407. Nest of 6 tubes, from 2 by $\frac{1}{2}$ inch to 6 by 1 inch, 10d.
 2408. Nest of 9 tubes, from $2\frac{1}{2}$ by $\frac{3}{8}$ inch to 7 by 1 inch, 1s. 3d.
 2409. Nest of 12 tubes, from $2\frac{1}{2}$ by $\frac{1}{4}$ inch to 9 by $1\frac{1}{2}$ inch, 2s.

TEST GLASSES ON FEET.



These Test Glasses are made either of Bohemian or of hard German white glass, which are not readily rendered opaque by the scratching of the stirrers as are the Test Glasses that are made of soft English flint glass.

2410. CLARK'S CONICAL TEST GLASS, Fig. 2410, 1 ounce size, $3\frac{1}{2}$ inches high, 2 inch diameter, with spout, made very broad, to show slight changes of color when a mass of liquor is looked through horizontally. *Per Dozen*, 3s.
2411. VERY SMALL LIGHT CONICAL TEST GLASS, form of Fig. 2410, 1 inch high, 1 inch diameter, with spout; for trying the action of small quantities of fluid on litmus paper, &c., as in the testing of water and dilute fluids. *Per Dozen*, 1s. 6d.
2412. CONICAL TEST GLASS, small and stout in the glass, for portable laboratory use, form of Fig. 2412, 1 inch diameter, 2 inches high, contents $\frac{1}{2}$ ounce, without stalk or spout. *Per Dozen*, 2s.
2413. BOHEMIAN TEST GLASSES, form of Fig. 2413, conical, with rounded bottom and spout, fine white glass, elegant form. *Price per Dozen.*
- | | | |
|-------------------|-------------------|----------------|
| 1 ounce, 3s. 6d. | 3 ounces, 5s. 6d. | 6 ounces, 8s. |
| 2 ounces, 4s. 6d. | 4 ounces, 6s. 6d. | 8 ounces, 10s. |

2414. FRENCH TEST GLASSES, conical, with spout, form of Fig. 2414. *Per Dozen*:—

1 ounce, 3s.	5 ounces, 5s.	12 ounces, 8s.
2 ounces, 3s. 6d.	6 „ 5s. 6d.	16 „ 10s.
3 „ 4s.	7 „ 6s.	24 „ 14s.
4 „ 4s. 6d.	8 „ 7s.	32 „ 18s.

CYLINDRICAL TEST GLASSES, with spout, form of Fig. 2415. *Per Dozen*:—

2415. Contents 2 ounces, $5\frac{1}{2}$ inches high, 1 inch wide, $3\frac{1}{2}$ inches deep within, 4s.	
2416. „ 4 „ $6\frac{1}{2}$ „ $1\frac{1}{2}$ inches wide, $4\frac{1}{2}$ „ „ 6s.	
2417. „ 6 „ 7 „ 2 „ $4\frac{1}{2}$ „ „ 7s.	
2418. „ 8 „ 7 „ $2\frac{1}{4}$ „ 5 „ „ 8s.	
2419. „ 12 „ 8 „ $2\frac{1}{2}$ „ 6 „ „ 9s.	

2420. CYLINDRICAL TEST GLASS, form of Fig. 2420, without spout, contents 18 to 20 ounces, 8 inches high, $3\frac{1}{2}$ inches wide, $4\frac{1}{2}$ inches deep within. *Per Dozen*, 12s.

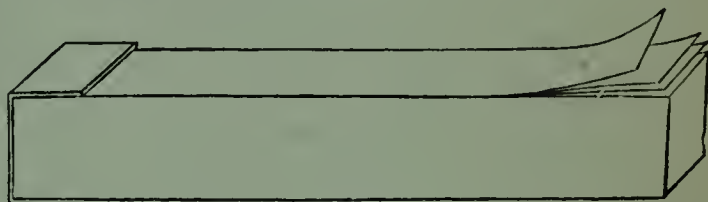
GLASS STIRRERS, suited to the different sizes of Test Glasses, see No. 115, page 12.

2421. GERMAN TEST TUBES ON FEET, with expanded mouth and spout, form of Fig. 2421. *Per Dozen*:—

1. $1\frac{1}{2}$ inches high, $\frac{1}{4}$ -inch wide, 1s.	4. 4 inches high, $\frac{5}{8}$ -inch wide, 1s. 6d.
2. 2 „ $\frac{3}{8}$ „ 1s. 2d.	5. 5 „ $\frac{3}{4}$ „ 1s. 9d.
3. 3 „ $\frac{1}{2}$ „ 1s. 4d.	6. 6 „ 1 „ 2s.

2422. TALL CONICAL TEST GLASS, champagne form, Fig. 2422, without spout, contents 10 ounces, 9 inches high, 3 inches wide, 1s.

2423. TEST PAPERS, DELICATE, bound in cheque books of 50 leaves each, size 3 inches long by $\frac{1}{3}$ inch wide, Fig. 2423.



The following kinds:—

2423.

- | | |
|--|--|
| 1. Blue Litmus, for Acids. | 4. Turmeric, for Alkalies. |
| 2. Red Litmus, for Alkalies. | 5. Brazil Wood, for Hydrofluoric Acid. |
| 3. Neutral Litmus, either for Acids or Alkalies. | 6. Lead, for Sulphuretted Hydrogen. |
| | 7. Starch, for Iodine. |

The Blue Litmus will detect half a grain of sulphuric acid in a gallon of water, namely 1 in 140,000. The Red Litmus will detect 1 grain of caustic soda in a gallon of water, or 1 in 70,000. The test papers are hard sized, so that lines can be drawn across them with the wet point of a glass rod, and thus many trials may be made with one leaf of paper.

2424. Price of a Single Book of Test Paper, 2d.
 2425. Test Paper Books, assorted, *per dozen*, 1s. 6d.
 2426. Wooden Box, with 6 Test Books, assorted, 1s.
 2427. Large Wooden Box, with 12 Books of Litmus, 2s.
 2428. Neat Case, containing 6 dozen Test Books, assorted, 9s.
 2429. Leather Case for the pocket, to hold one Test Book, 4d.



2429.

2430. Leather Case, with one book of blue or neutral litmus, 6d.

Japanned Tin-plate Cases, with hinged tops, *at the same price as leather cases*.

2431. Stoppered Glass Bottle, with 12 Books Neutral Litmus, 3s.

2432. **TEST PAPERS FOR LECTURERS.**—Test Papers, strongly coloured, and of large size, 5 inches long, $\frac{3}{4}$ inch wide, for experiments at lectures; in a pasteboard box, containing 6 books, namely, blue and red litmus, yellow and brown turmeric, lead paper, and starch paper, each book containing 3 leaves, per box, 1s. 6d.
2433. Any of the Books separately, 3d. *each*.
2434. Ozone Paper, per packet of 60 leaves, 5 inches long, 2 inches wide, 1s.
2435. Lowe's Ozone Box, for exposing Ozone Papers to the free action of the air in the shade, 15s.
2436. **TEST METALS.**—An assortment of small metallic bars and wires for precipitating metals in qualitative Testing, in a turned wooden box, 1s.
2437. The metals separately, each 1d.
 Iron Bar. Zinc thin Wire. Copper thin Wire. Lead Wire.
 Zinc Bar. Copper Plate. Tin Wire.
2438. **Test Spoon**,—a small spoon of polished German silver, with a bowl $\frac{1}{4}$ inch diameter, for lifting small quantities of powder, fluxes, &c., the handle fashioned into a spatula, $3\frac{1}{2}$ inches long, Fig. 2438, 3d.
2439. **PORCELAIN TESTING SLABS**, square Plates of White Glazed Porcelain, with 12 flat cavities for Testing Liquors that give Coloured Precipitates, as fully explained at No. 2815. Fig. 2439, *two sizes*:—
2439. Berlin Porcelain, $4\frac{1}{2}$ by $3\frac{1}{2}$ inches, with 12 cavities, $\frac{3}{4}$ inch diameter, 1s. 6d.
2440. Thuringian Porcelain, $3\frac{3}{4}$ by 3 inches, with 12 cavities, $\frac{5}{8}$ inch diameter, 1s.
2441. Round flat Plates of Berlin Porcelain, white and glazed, with depression in the middle like that of dinner plates, for use instead of Watch Glasses in examining Coloured Precipitates.
 $1\frac{1}{2}$ inch diameter, 2d.; $1\frac{3}{4}$ inch diameter, 2d.
2442. **PIPETTES** for applying Tests in Drops, &c. See No. 1690.
2443. **PIPETTE BOTTLES** for Tests. See No. 1556.



2438.



2439.

CHEMICAL TESTS IN SOLUTION.

2445. The REAGENTS enumerated in the following Table are carefully prepared, in accordance with the STRENGTH and PURITY recommended by Rose, Fresenius, and other analytical chemists. But with this difference,—that, whereas it is usual to prepare solutions of tests according to certain variable and not very precise standards, such as 1 to 5 of water, 1 to 12, 1 to 15, 1 to 24, &c., an attempt is now made to give to each solution an ATOMIC STRENGTH. The standard of measurement fixed upon is the *Decigallon*, and ONE ATOM of any chemical substance, weighed in grains, and made into a solution of the bulk of a Decigallon, at 62° F., is called a solution of ONE DEGREE STRENGTH (marked 1°). If 2 atoms are dissolved in a solution of that bulk, it is a solution of 2°. If 5 atoms are dissolved, it is a solution of 5°, and so on.

As the measure which in this work is called a SEPTUM, is the *thousandth part* of a DECIGALLON, it follows, that, with a pipette graduated into Septems, the $\frac{1}{1000}$ th part of an atom of any chemical substance contained in a solution of 1°, or any number of $\frac{1}{1000}$ th parts, can be readily measured. In like manner, Equivalent Quantities of any two liquors, susceptible of double decomposition, can be measured off for effecting such a decomposition. Thus, 10 Septems of Chloride of Barium will decompose 5 Septems of Sulphate of Sodium of 10°. Consequently, test liquors prepared on this plan, can not only be used for all the processes of quantitative analysis, but serve also, to a certain extent, or quantitative experiments. They are also adapted to ensure the Lecturer against the

of occasionally failing in the performance of Class Experiments, in consequence of his not knowing the strength of the solutions he has occasion to mix together, to produce a desired effect. Indeed, the conveniences that must result from the use of test solutions of *systematic degrees of strength* are so obvious, that chemists would, no doubt, have long ago been accustomed to use them, but for the circumstance, that the arrangement cannot be successfully extended to the entire series of chemical reagents. With some reagents it is difficult and troublesome to *ascertain* the degree of strength of the solutions; with others it is yet more difficult to *preserve* the solutions in an *unaltered* condition. The *reagents* which decompose in water, either cold, or during changes of temperature, and those which rapidly absorb oxygen or carbonic acid from the atmosphere, cannot possibly be the subjects of successful commercial dispensation in the form of accurate test solutions. Every chemist who wishes to use such changeable tests in a state of absolute purity must himself prepare the solutions when he wants them for instant use. But the circumstance, that these changeable compounds cannot be kept in a pure state, nor of fixed strength, need not prevent the systematic use of other reagents to which objections of the same kind do not apply. I therefore venture to recommend this subject to the consideration of chemists, although it is thus encumbered with difficulties. This much will be gained at any rate; the unchangeable test liquors will be more useful than hitherto, while those that are changeable will be no worse than they always were.

I must add a caution on another point. Although these test solutions are **VOLUMETRIC**, they must not be confounded with the solutions that are expressly prepared for volumetric analysis, and which are described in the next Section of this work. In both cases, indeed, the strength expressed in Degrees is quoted in the description of each particular test solution; but the solutions of chemicals now under consideration are *strong* solutions, some of them nearly or quite *saturated*, while the solutions for volumetric analysis are all made *very dilute*. I may add further, that the chemical strength of these strong test solutions is not adjusted with the same exactness as that of the dilute solutions for Volumetric analysis. In the latter case, great accuracy is indispensable, and only such liquors are used as can be graduated with precision. In the former case, such exactness is in some instances unnecessary; in many cases it is not attainable; and in other cases, it is not so desirable as to warrant the great expense that would be incurred in effecting it.

For the sake of convenience in Analysis, bottles to contain Acids and Alkalies are put into the following series; but as such liquids cannot be sent by Railway, or by Ship, without being "DECLARED," they require to be packed in a separate Case for travelling. See Article ACIDS in the General List of Chemicals.

1446. The Test Solutions are supplied at the prices quoted in the columns marked B in the following Table, in narrow-mouthed white hard German glass stoppered bottles, of the form and superior quality described at No. 1551 in this work. The bottles have printed labels, stating the particulars that are given in this Table.

If the Test Solutions are supplied in bottles of the form and quality described at No. 1550 in this work, the prices are reduced to the terms stated in the columns marked A. These bottles are not so elegant as those of class B, nor are they so carefully stoppered. If the Tests are required for travelling cabinets, those of class B are much to be preferred to those of class A. But the latter are quite sufficient for ordinary laboratory use.



1551.

1550.

No.	NAME OF THE REAGENT.	SYMBOL.	ATOMIC WEIGHT.	ATOMS IN 1000 SEPTIMS.	GRAINS IN 1 SEPTIM.
2447	Acetic Acid	$\text{H}, \text{C}^2\text{H}^3\text{O}^2$	60	40	2·4
2448	Alcohol, Sp. gr. 805	$\text{H}, \text{C}^2\text{H}^5\text{O}$	46		
2449	Ammonium, Carbonate	$\text{NH}^4, \text{NH}^4, \text{CO}^3$	96	15	1·44
2450	Ammonia	NH^3	17	40	·68
2451	Ammonium, Chloride	NH^4, Cl	53·5	20	1·07
2452	Ammonium, Molybdate	$\text{NH}^4, \text{MoO}^2$	98	2	·196
2453	Ammonium, Oxalate	NH^4, CO^2	62	4	·248
2454	Ammonium, Sulphide	NH^4, S	34	10	·34
2461	Barium, Acetate	$\text{Ba}, \text{C}^2\text{H}^3\text{O}^2$	127·5	4	·51
2462	Barium, Chloride	BaCl	104	5	·52
2463	Barium, Hydrate	BaHO	85·5	2	·171
2464	Barium, Nitrate	BaNO^3	130·5	3	·391
2470	Calcium, Chloride	CaCl	55·5	20	1·11
2471	Calcium, Hydrate	CaHO	37	·4	·014
2472	Calcium, Nitrate	CaNO^3	82	10	·82
2473	Calcium, Sulphate	CaSO^2	68	·25	·01
2475	Chlorine Water, <i>saturated</i>	Cl			
2476	Cobalt, Nitrate	CoNO^3	91·5	5	·45
2477	Copper, Sulphate	Cu^2SO^2	79·75	5	·39
2483	Ether, Sulphuric	$\text{C}^2\text{H}^5, \text{C}^2\text{H}^5\text{O}$	74		
2491	Gold, Terechloride	Au^2Cl	101	3	·30
2496	Hydrochloric Acid	HCl	36·5	50	1·82
2497	Hydrofluosilicic Acid	HSi^2F^3	72	3	·21
2498	Hydrosulphuric Acid	HS	17	2	·01
2499	Ferric Chloride	Fe^3Cl	54·16	10	·54
2500	Ferric Sulphate	Fe^3SO^2	66·66	10	·66
2501	Ferrous Sulphate	FeSO^2	76	10	·76
2505	Indigo, Sulphate				
2510	Lead, Acetate	$\text{Pb}, \text{C}^2\text{H}^3\text{O}^2$	162·5	4	·64
2511	Lead, Nitrate	PbNO^3	165·5	4	·64
2514	Magnesium, Sulphate	MgSO^2	60	5	·3

Contents of the Bottles in Fluid Ounces.

No.	2 oz.		3 oz.		4 oz.		6 oz.		10 oz.		20 oz.	
	A	B	A	B	A	B	A	B	A	B	A	B
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
2447	1 —	1 3	1 1	1 7	1 4	2 —	1 9	2 4	2 9	3 5	5 —	5 8
2448	1 1	1 6	1 5	1 11	1 10	2 4	2 6	3 1 4	—	4 8	7 6	8 2
2449	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2450	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2451	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2452	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2453	— 8	1 1	— 10	1 4	1 —	1 6	1 3	1 10	1 10	2 6	3 4	4 —
2454	— 10	1 3	1 1	1 7	1 4	2 —	1 9	2 4	2 9	3 5	5 —	5 8
2461	— 9	1 2	— 11	1 5	1 2	1 8	1 6	2 1	2 4	3 —	4 2	4 10
2462	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2463	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2464	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2470	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2471	— 6	— 11	— 6	1 —	— 7	1 2	— 8	1 3	1 —	1 7	1 3	1 11
2472	— 8	1 1	— 10	1 4	1 —	1 6	1 3	1 10	1 11	2 6	3 4	4 —
2473	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2475	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2476	1 9	2 2	2 5	2 11	3 2	3 9	4 6	5 1 7	—	7 8	12 6	13 2
2477	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2483	1 3	1 8	1 8	2 2	2 2	2 9	3 —	3 7	4 9	5 5	9 4	10 —
2491	8 5	8 10	12 5	13 —	16 6	17 —	24 —	24 6	40 —	40 8	80 —	80 8
2496	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 2	2 6	3 2
2497	— 10	1 3	1 1	1 7	1 4	2 —	1 9	2 4	2 9	3 5	5 —	5 8
2498	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 2	2 6	3 2
2499	— 8	1 1	— 9	1 3	— 11	1 5	1 2	1 9	1 8	2 4	2 11	3 7
500	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
501	— 7	1 —	— 8	1 1	— 9	1 3	— 11	1 6	1 3	1 11	2 1	2 9
505	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
510	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
511	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
514	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
	A	B	A	B	A	B	A	B	A	B	A	B

No.	NAME OF THE REAGENT.	SYMBOL.	ATOMIC WEIGHT.	ATOMS IN 1000 SEPTEMS.	GRAINS IN 1 SEPTEM.
2516	Mercuric Chloride	HgCl	135.5	3	.4065
2517	Mercurous Nitrate	HgNO ³	262	1	.262
2518	Mercuric Potassio-Iodide	KI, HgCl	393	1	.393
2522	Nitric Acid	HNO ³	63	30	1.89
2523	Oxalic Acid	HCO ²	45	10	.45
2527	Platinic Chloride	PtcCl	85	8	.68
2529	Potassium, Bicarbonate	KHCO ³	100	10	1.1
2530	Potassium, Carbonate	K ² CO ³	138	10	1.38
2531	Potassium, Bichromate	2KCrO ³ + Cr ² O ³	295	2	.59
2532	Potassium, Chromate	KCrO ²	97.25	5	.49
2533	Potassium, Cyanide	KCN	65	10	.65
2534	Potassium, Ferridcyanide	KCy, FecCy	109.66	6	.658
2535	Potassium, Ferrocyanide	K ² FeCy ³	184	3	.552
2536	Potassium, Hydrate	KHO	56	20	1.12
2537	Potassium, Iodide	KI	166	5	.83
2539	Potassium, Sulphate	KSO ²	87	5	.435
2540	Potassium, Sulphocyanide	K, CN, S ²	97	5	.485
2550	Silver, Nitrate	AgNO ³	170	2	.34
2555	Sodium, Acetate	Na, C ² H ³ O ²	82	5	.41
2557	Sodium, Bitartrate	NaC ² H ² O ³ + H, C ² H ² O ³	172	4	.688
2558	Sodium, Carbonate	Na ² CO ³	106	10	1.06
2559	Sodium, Chloride	NaCl	58.5	10	.585
2560	Sodium, Hydrate	NaHO	40	20	.8
2561	Sodium, Phosphate	Na ² H, PO ⁴	142	2	.284
2562	Sodium, Sulphate	NaSO ²	71	10	.71
2563	Sodium, Sulphide	NaS	39	5	.195
2571	Sulphuric Acid	HSO ²	49	50	2.45
2572	Sulphuric Acid, <i>concentrated</i>	HSO ²	49	263	12.8
2576	Stannous Chloride	SnCl	94.5	5	.4725
2577	Starch (<i>permanent solution</i>)	InCaCl + NaCl	..	..	..

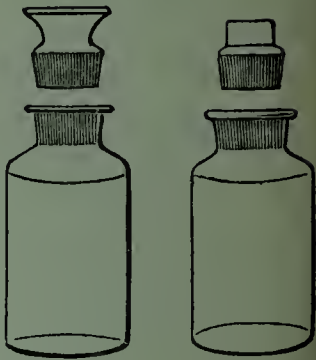
Contents of the Bottles in Fluid Ounces.

No.	2 oz.		3 oz.		4 oz.		6 oz.		10 oz.		20 oz.	
	A	B	A	B	A	B	A	B	A	B	A	B
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
2516	— 8	1 1	— 10	1 4	1 —	1 6	1 3	1 10	1 11	2 6	3 4	4 —
2517	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2518	— 11	1 4	1 2	1 8	1 6	2 —	2 —	2 7	3 2	3 9	5 10	6 6
2522	— 8	1 1	— 10	1 4	1 —	1 6	1 3	1 10	1 11	2 6	3 4	4 —
2523	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2527	6 5	6 10	9 5	9 11	12 6	13 —	18 6	19 1	30 8	31 4	61 —	61 8
2529	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2530	— 9	1 2	— 11	1 5	1 2	1 8	1 6	2 1	2 4	2 11	4 2	4 10
2531	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2532	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2533	— 11	1 4	1 2	1 8	1 6	2 —	2 —	2 7	3 2	3 9	5 10	6 6
2534	— 8	1 1	— 10	1 4	1 —	1 6	1 3	1 10	1 11	2 6	3 4	4 —
2535	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 1	2 6	3 2
2536	— 9	1 2	— 11	1 5	1 2	1 8	1 6	2 1	2 4	2 11	4 2	4 10
2537	— 11	1 4	1 2	1 8	1 6	2 —	2 —	2 7	3 2	3 9	5 10	6 6
2539	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2540	— 8	1 1	— 9	1 3	— 11	1 6	1 2	1 9	1 8	2 4	2 11	3 7
2550	1 2	1 7	1 6	2 —	2 —	2 6	2 9	3 4	4 6	5 2	8 —	8 8
2555	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2557	— 8	1 1	— 10	1 4	1 0	1 6	1 3	1 10	1 11	2 6	3 4	4 —
2558	— 7	— 11	— 8	1 2	— 10	1 5	1 —	1 7	1 6	2 2	2 4	3 —
2559	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2560	— 8	1 1	— 10	1 4	1 —	1 6	1 3	1 10	1 11	2 6	3 4	4 —
2561	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2562	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
2563	— 7	1 —	— 8	1 2	— 10	1 5	1 —	1 7	1 6	2 2	2 6	3 2
2571	— 7	1 —	— 8	1 2	— 10	1 4	1 —	1 7	1 6	2 2	2 6	3 2
2572	— 9	1 2	— 11	1 5	1 2	1 9	1 6	2 1	2 4	3 —	4 —	4 8
2576	— 8	1 1	— 9	1 3	— 11	1 6	1 2	1 9	1 8	2 4	2 11	3 7
2577	— 6	— 11	— 7	1 1	— 8	1 2	— 9	1 4	1 1	1 8	1 8	2 4
	A	B	A	B	A	B	A	B	A	B	A	B

TESTS TO BE KEPT IN THE DRY STATE.

2600. These Tests consist of substances which require to be used in the solid form, or of those the solutions of which undergo spontaneous decomposition, or which attack the bottles or fix the stoppers. They also include materials for the production of the Gases that are used in Analysis.

The Reagents are packed in wide-mouthed German white glass stoppered bottles of the capacity of 2, 6, 10, and 20 fluid ounces. The bottles are filled. There are two kinds of bottles. Those marked B are of the fine quality and good form described at No. 1577. Those marked A are of the form and quality described at No. 1576. Both correspond with the narrow-mouthed Solution bottles described at No. 2446.



The PRICES include the Cost of the BOTTLES.

No.	TESTS.	2 ounce.		6 ounce.		10 ounce.	
		A	B	A	B	A	B
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
2602	Ammonium, Sesquicarbonate	— 10	1 2	1 7	2 —	2 1	2 8
2603	Ammonium, Nitrate, cryst.	1 —	1 4	2 —	2 5	3 3	3 10
2604	Barium, Acetate, cryst.	2 —	2 4	4 2	4 7	6 6	7 1
2606	Barium, Carbonate, pasty	1 11	2 3	3 11	4 4	6 —	6 7
2607	Barium, Hydrate, cryst.	2 —	2 4	4 2	4 7	6 6	7 1
2610	Calcium, Fluoride	— 10	1 2	1 2	1 7	1 5	2 —
2611	Copper, precipitated						
2612	Gall Nuts in powder	— 9	1 1	1 4	1 9	1 10	2 5
2613	Ferrous Sulphate, cryst., granul.	1 1	1 5	2 1	2 6	3 —	3 7
2615	Lime, Chloride	— 8	1 —	1 —	1 5	1 3	1 10
2616	Litmus	1 1	1 5	2 —	2 5	2 8	3 3
2617	Oxalic Acid, cryst.	1 4	1 8	2 8	3 1	2 9	3 4
2619	Potassium, Hydrate, partially purified	1 2	1 6	2 5	2 10	3 6	4 1
2620	— by Alcohol, nearly pure	2 —	2 4	4 6	4 11	7 1	7 8
2621	Potassium, Red Chromate	1 8	2 —	3 4	3 9	5 1	5 8
2625	Sodium, Hydrate, partially purified	1 2	1 6	2 5	2 10	3 6	4 1
2626	— by Alcohol, nearly pure	2 —	2 4	4 6	4 11	7 1	7 8
2627	Sodium, Chloride	— 11	1 3	1 9	2 2	2 5	3 —
2628	Sodium, Nitrate	— 9	1 1	1 4	1 9	1 9	2 4
2629	Sodium, Sulphide	1 8	2 —	3 6	3 11	5 6	6 1
2631	Tartaric Acid, cryst.	1 7	1 11	3 3	3 8	5 —	5 7
2632	Tin, Protochloride, cryst.	1 6	1 10	3 1	3 6	4 10	5 5
2633	Zinc, pure in rods	2 6	2 10	4 6	4 11	7 1	7 8
2636	Flux for Silicates, KNaCO ³	1 7	1 11	3 3	3 8	5 —	5 7

SUBSTANCES FOR PREPARING GASES.

No.		6 ounce.		10 ounce.		20 ounce.	
		A	B	A	B	A	B
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
2640	Iron, Sulphide. For HS	1 2	1 7	1 7	2 2	2 8	3 3
2641	Manganese, Peroxide. For Cl	— 11	1 4	1 1	1 8	1 8	2 3
2642	Potassium, Chlorate. For O	1 9	2 2	2 1	2 8	3 8	4 3
2643	Zinc, granulated. For H	1 —	1 5	1 4	1 11	2 —	2 7
2644	Carrara Marble. For CO ²	1 3	1 8	2 —	2 7	3 3	3 10
2645	Fluor Spar. For HF	1 2	1 7	1 5	2 —	2 —	2 7

TEST PAPERS. See No. 2423.

TEST METALS. See No. 2436.

BLOWPIPE REAGENTS.

No.		2 ounce.		6 ounce.		10 ounce.	
		A	B	A	B	A	B
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
2650	Borax	— 11	1 3	1 8	2 1	2 3	2 10
2651	Microcosmic Salt	1 6	1 10	3 1	3 6	4 7	5 2
2652	Sodium, Carbonate	— 10	1 2	1 6	1 11	2 1	2 8
2653	Potassium, Cyanide	1 10	2 2	3 9	4 2	5 10	6 5
2476	Cobalt, Nitrate, <i>solution</i>	1 9	2 2	4 6	5 1	7 —	7 8
2655	Potassium, Bisulphate	1 1	1 5	2 —	2 5	2 11	3 6
2656	Potassium, Nitrate	1 —	1 4	1 9	2 2	2 7	3 2
2658	Boracic Acid, fused	1 9	2 1	3 7	4 —	5 7	6 2
2659	Gypsum, crystallised	1 9	2 1	3 7	4 —	5 7	6 2

COLLECTIONS of CHEMICAL TESTS, contained in PORTABLE CABINETS. For Particulars refer to the Section on CHEMICAL CABINETS.

In ordering Reagents from the preceding Lists, it is only necessary to specify the No. and the size of the bottle desired.

Volumetric Analysis.

Those who wish to study the general principles of Volumetric Analysis, or to become acquainted with the special rules for the practice of that art, will necessarily refer to works that treat expressly on those subjects. Among such works, I may mention MOHR'S *Lehrbuch der Titrimethode*, 1862; SUTTON'S *Handbook of Volumetric Analysis*, 1863; FRESSENIUS'S *Quantitative Chemical Analysis*, 1860, or the later German edition of that work; and, finally, the Tenth edition of GRIFFIN'S *Chemical Recreations*.

I propose, in this work, merely to refer to a number of practical points; such as the varieties and relative merits of the necessary apparatus, the way to handle it so as to ensure the best results, the composition of the principal Test solutions, with short notices of the purposes to which they are to be applied; and an account of the weights, measures, and methods of reckoning employed in Volumetric Analysis. Where it can be done with brevity, I shall give instructions for performing the analytical operations; but I cannot enter fully into the long details which the explanation of certain processes demand, and I by no means propose to supersede the use of books written expressly to teach the art of Volumetric Analysis.

WEIGHTS AND MEASURES USED IN VOLUMETRIC ANALYSIS.

2675. Instruments for use in Volumetric Analysis are so graduated, that the unit of measurement is the thousandth part of the capacity of the vessel in which the Normal or Standard Test liquor are prepared. Each unit of measurement therefore contains the $\frac{1}{1000}$ th part of the pure chemical substance that is dissolved in the standard measure to prepare any given test liquor.

At the present time, three different units of measurement are in use among English chemists:—

The first is the CENTIMETRE CUBE. When this unit is used, the test liquors are prepared in the LITRE, which contains 1000 Centimetre Cubes.

The second is the DECEM, or the measure of 10 English grains of water at 62° Fahr. For use with this measure, the test liquors are prepared in a vessel that contains 1000 DECEMS, or 10,000 grains of water.

The third unit is the SEPTEM, which contains 7 English grains of water at 62° Fahr. The test liquors to be used with this measure are prepared in a DECIGALLON, which contains 1000 Septems; and is the tenth part of an Imperial gallon, or has the capacity of 16 fluid ounces, or an avoirdupoise pound of Water. A Burette containing 100 Septems measures the hundredth part of the Imperial gallon.

In MOHR'S *Lehrbuch*, the unit adopted is the Centimetre Cube. In SUTTON'S *Handbook*, it is the Centimetre Cube, and subordinately the Decem. In GRIFFIN'S *Chemical Recreations*, and in many parts of the present work, it is the Septem.

RELATION OF THE KILOGRAMME TO THE BRITISH POUND, AND OF THE LITRE TO THE PINT

2676. According to the Act of Parliament, passed in the year 1864, "*To render permissive the Use of the Metric System of Weights and Measures*," the Kilogram is said to be equivalent to 15432.3487 British Grains, and the Litre to be equivalent to 1.76077 British Pints.

As the number of grains in a pound is 7000, and the number of grains of water in a pint is 8750, we deduce thence the following equivalents:—

$$15432\cdot3487 \div 7000 = 2\cdot20462125 \text{ Imperial Pounds in a Kilogram.}$$

$$1\cdot76077 \times 8750 = 15406\cdot7375 \text{ Grains of water in a Litre.}$$

$$15406\cdot7375 \div 7000 = 2\cdot2009625 \text{ Pounds of water in a Litre.}$$

A Gramme (or Gram, as it is spelt in the Act of Parliament) is the 1000th part of a Kilogramme, and a Centimetre Cube is the 1000th part of a Litre. Consequently,—

$$\text{A Gram weighs against brass} \quad 15\cdot4323487 \text{ English Grains.}$$

$$\text{A Centimetre Cube contains of water} \quad 15\cdot4067375 \text{ English Grains.}$$

$$\text{Differencee} = 0\cdot0256112 \text{ English Grain.}$$

The Schedule of comparative Weights and Measures which is attached to "*The Metric Weights and Measures Act, 1864*," contains no reference to temperature, or other conditional circumstances affecting the ascertainment of standards; but, as the English Standard Weights, to which the Kilogram is compared, are adjusted at 62° Fahr., and weighed in the open air against weights made of brass, while the French Standards are weighed in a vacuum, at the temperature of the maximum density of water, about 39·1° Fahr., these differences in the mode of establishing standards must be taken into consideration in all comparisons of French and English Weights and Measures. In France, a centimetre cube of water is said to weigh a gramme, but the centimetre cube of water, as now legalised in Britain, does not weigh a gramme: there is a difference of 0·0256112 English grain. Our Parliamentary Metrical system is built therefore on a false basis.

EASY CONVERSION OF FRENCH DECIMAL MEASURES INTO ENGLISH DECIMAL MEASURES.

2677. The English Gallon contains 10 pounds of water. The measure of one pound of water is a Deeigallon. The grains of water in a Deeigallon are 7000. If we take as a unit of measurement the bulk of seven grains of water, and call it a *Septem*, we have in the Deeigallon 1000 Septems; and, consequently, the relation of the Septem to the Deeigallon is the same as that of the Centimetre Cube to the Litre.

2678. In order to avoid the trouble of making calculations with Decimals having many figures, I propose to consider the Kilogram as being equal to 2·2 lbs., and the Litre as equal to 2·2 Deeigallons. The errors involved in this proposal are as follow:—The Kilogram is undervalued by 46 in 22046, equal to 1 in 480, or 32 grains by weight in the Kilogram. The Litre is undervalued by 1 in 2200, or 6½ grains by measure in the Litre. The last error is one that, with ordinary measures, is scarcely capable of experimental detection; and even the former is of little practical importance; so that for technical and commercial purposes these equivalents may be safely adopted, in calculating the relations of the Metric and British weights and measures.

2679. SUGGESTED EQUIVALENTS OF METRIC AND BRITISH WEIGHTS AND MEASURES.

$$1 \text{ Gramme} = 15\cdot4 \text{ Grains.}$$

$$1 \text{ Centimetre Cube} = 2\cdot2 \text{ Septems} = 15\cdot4 \text{ Grains of Water.}$$

$$1 \text{ Kilogramme} = 15400 \text{ Grains} = 2\cdot2 \text{ avoirdupois lbs.}$$

$$1 \text{ Litre} = 2200 \text{ Septems} = 2\cdot2 \text{ Deeigallons.}$$

$$1 \text{ Septem} = \cdot454546 \text{ Centimetre Cube.}$$

$$1 \text{ Deeigallon} = 454\cdot546 \text{ Centimetre Cubes} = 1 \text{ lb. of Water.}$$

$$1 \text{ Gallon} = 4545\cdot46 \text{ Centimetre Cubes} = 4\cdot54546 \text{ Litres} = 10 \text{ lbs. of Water.}$$

$$1 \text{ Decem} = \cdot649351 \text{ Centimetre Cube.}$$

$$1 \text{ Fluid Drachm} = 54\cdot6875 \text{ Grains} = 7\cdot8125 \text{ Septems} = 3\cdot5511 \text{ Cent. Cubes.}$$

$$1 \text{ Minim} = \cdot91146 \text{ Grain of Water.}$$

The Fluid Drachm and Minim, quantities which have these very awkward relations both to English and French standards, have been adopted by the compilers of the British Pharmacopœia of 1864.

RELATION OF NORMAL TEST LIQUORS TO THE THREE UNITS OF MEASUREMENT.

2680. I take oil of vitriol or hydrated sulphuric acid, HSO_2 , as an example. Its atomic weight is 49:—

a. For a LITRE, 49 grammes by weight of the acid are diluted with water to a Litre by measure.

b. For 1000 DECEMS, $49 \times 10 = 490$ grains of the acid by weight are diluted to 1000 Deeems by measure.

c. For a DECIGALLON, or 1000 SEPTEMS, $49 \times 7 = 343$ grains of the acid by weight are diluted to a Deeigallon by measure.

2681. These three liquors, so differently prepared, are IDENTICAL IN STRENGTH, provided the Gramme is made equivalent to 15·4 grains, and the Centimetre Cube to 2·2 Septems. 1 Centimetre Cube of any one of the liquors then contains the $\frac{1}{1000}$ th part of 49 Grammes of HSO_2 . 1 Decem

of each contains the $\frac{1}{1000}$ th part of 490 Grains, and 1 Septem contains the $\frac{1}{1000}$ th part of 343 grains of the acid. The reason of this is, that

$$\begin{array}{rclclcl} 1 \text{ Gramme} & = & 7 \text{ Grains} & = & 10 \text{ Grains} \\ \text{per Litre} & & \text{per Decigallon} & & \text{per Decem.} \\ \text{Because,—} & & & & \\ 15.4 \text{ Grains in } 15.400 & = & 7 \text{ Grains in } 7000 & = & 10 \text{ Grains in } 10000. \end{array}$$

The same liquor could therefore be used in analyses, with Burettes graduated according to any of the three systems.

But, necessarily, if the Centimetre Cube is taken as equivalent to 15.4 grains of water by volume, while the brass gramme that is made use of is equivalent to 15.4323487 grains by weight, the test liquors made with materials weighed with such a gramme will be, as above noted, about one-fifth of a per cent., or 1 in 500, stronger than if made with grain weights. If a correction on this account is considered to be necessary, it is very easy to make it. Thus, to reduce gramme solutions to grain solutions, 500 volumes are to be diluted with water to 501 volumes. To strengthen grain solutions to gramme solutions, $\frac{1}{500}$ th part by weight of the solid contents must be added to 501 volumes by measure.

CONVERSION OF FRENCH PRESCRIPTIONS INTO ENGLISH.

2682. It is here assumed that the prescriptions refer to solid bodies weighed in grammes, and to liquids measured in Centimetre Cubes, and that the English weights are grains, and the measures Decems or Septems.

a. With Septem Measures.—For the liquids, use Septems instead of Centimetre Cubes. For the solids, multiply the grammes by 7, and weigh the products in grains.

b. This conversion gives the ratios of the substances correctly, but, to determine the *absolute quantities*, each product must be multiplied by 2.2. For approximate quantities, the figures expressing the ratios have merely to be doubled.

c. With Decem Measures.—For the liquids, use Decems instead of Centimetre Cubes. For the solids, multiply the Grammes by 10, and weigh the products in grains. To find the absolute quantities, multiply each product by 1.54. For approximate quantities, take each product $1\frac{1}{2}$ times.

Of course, these two calculations come to the same thing as the process of multiplying both the Grammes and the Centimetre Cubes, of the original prescriptions directly with 15.4, signifying grains; but it often happens that only the ratios are required, the persons who use the Septem or Decem measures intending to use other absolute quantities.

By adopting the English Decimal system afforded by the Septem, the labour of rendering French prescriptions into English is much lessened. The following example will illustrate this point:—

Prescription from a French work on Photography.	Equivalent Quantities after 2682 <i>a.</i>	Absolute quantities after 2682 <i>b.</i>
Azotate d'argent 30 grammes.	210 grains.	462 grains.
Aeide acétique 36 grammes.	252 grains.	554.4 grains.
Eau distillée 500 C C.	500 septems.	1100 septems.

Calculations.— $30 \times 7 = 210$, and $210 \times 2.2 = 462$.
 $36 \times 7 = 252$, and $252 \times 2.2 = 554.4$.
 $500 \times 1 = 500$, and $500 \times 2.2 = 1100$.

When exactness is demanded, $\frac{1}{500}$ th part in volume is to be added to the liquid, making the above quantities 501 instead of 500 Septems, and 1102.2 instead of 1100 Septems.

In the British Pharmacopœia, the following equivalents are given to assist Apothecaries in translating prescriptions:—

1 pound = 453.5925 grammes.	1 pint = 0.567936 litres.
1 ounce = 28.3495 grammes.	1 fluid ounce = 0.028396 litres.
1 grain = 0.0648 grammes.	1 fluid drachm = 0.003549 litres.
	1 minim = 0.000059 litres.

If an attempt be made to translate the above simple prescription by means of these equivalents the reckoning will be found to be much more complicated.

CHOICE OF A UNIT OF MEASUREMENT FOR GRADUATED TEST SOLUTIONS.

2683. Dr. Mohr recommends *NORMAL Volumetric Solutions* to be prepared by weighing an atomic weight of any chemical substance in grammes, and making with that quantity a solution that measures a Litre. This strength is, as I have shown, the same as that obtained by weighing 1 atom in English grains, and making with that quantity a solution of 1000 Decems, or by making with 7 atoms in grains a solution measuring a Decigallon.

But solutions of that strength have been found to be, in the majority of cases, too strong for

convenient use, and accordingly another series of solutions have been made, which have only one-tenth part of the strength of the Normal solutions, and these are called DECI-NORMAL.

In English manufactories, where liquids are measured by the gallon, and solids weighed by the pound, neither the Centimetre Cube nor the Decem present the advantages that are offered by the Septem, by which the English weights and measures are readily thrown into a decimal system as perfect in theory and as convenient in practice as the French system. 1000 Septems make a Decigallon. The Decigallon of water weighs one Imperial pound, and is the tenth part of the Imperial gallon. Hence the results of analyses of small quantities of chemical products, measured in Septems, can be transferred to pounds and gallons with the greatest facility.

Normal volumetric solutions of the strength shown above would, on the septem standard, require 7 atoms of the chemical, weighed in grains, to be dissolved in a Decigallon of solution, and Deci-normal solutions would have to be made with $\frac{7}{10}$ th atom in a Decigallon. These are not convenient numbers, and I prefer the following:—

In the great majority of cases, the strength obtained by one atom, weighed in grains and made into a Decigallon of solution at 62° F., is very convenient. The strength is equal to $\frac{10}{9}$ or about $1\frac{1}{2}$ times that of Mohr's Deci-normal solutions. It serves, therefore, for all the purposes for which those solutions are used, and also for most of the experiments for which the Normal solutions are commonly taken. And having one chemical atom in 1000 septems, or the $\frac{1}{1000}$ th part of an atom in every septem, the strength of the solution is such as to render all calculations extremely easy.

When it is desirable to have still weaker solutions, half an atom per Decigallon can be taken; while for the cases where strong solutions are necessary, those made with 5 atoms per Decigallon will be found amply sufficient, and they afford easy calculations. I have given in the last edition of "CHEMICAL RECREATIONS" an account of some important volumetric solutions prepared on this scale; and many others will be noticed in the present work.

A little consideration of the foregoing particulars will show that the Septem standard, taken in relation to volumetric analysis, is quite as convenient as the Centimetre Cube; while in its character as an integral part of a decimal system of English weights and measures, it is greatly superior.

2683 a. EMPIRICAL TEST SOLUTIONS.—Independently of the test solutions that may be prepared on a systematic plan resting upon the atomic weights of the substance, or upon this or that unit of measurement, it is frequently, nay, commonly, demanded by manufacturers whose operations of Chemical Testing fall to be made by workmen, that the Test Solutions to be used shall be so prepared that the measures of the burette shall directly indicate percentages, not referring to atomic weights, but to 100 or other round number of grains of some given substance contained in the crude mixture that is subjected to analysis. A test solution prepared with this view is said to be *empirical*; that is to say, it is not in accordance with the scientific system observed by the philosophical chemist in his investigations. Every test liquor prepared for a technical purpose of this nature must be made to suit the special wants of the manufacturer, and accord with the graduation of the instruments that he is accustomed to make use of.

2683 b. CHOICE OF THE QUANTITY OF A CRUDE SUBSTANCE THAT IS TO BE TAKEN FOR A VOLUMETRIC ANALYSIS.—The quantity of any substance to be taken for analysis depends upon the kind of graduation employed, and the strength of the test solution. When Normal solutions and centimetre graduation are used, the quantity of substance to be taken is the $\frac{1}{10}$ th part of an atom weighed in grammes, and for Deci-normal solution, the quantity to be taken is the $\frac{1}{100}$ th part of an atom weighed in grammes; because, in these cases, the number of Centimetre Cubes of the test liquors that are required to complete the analyses indicate that so many *per cents.* of the pure chemicals are present in the crude substances that are submitted to analysis. In like manner, when Normal solutions and the Decem graduations are employed, the quantity of substance to be taken is 1 atom weighed in grains, and for Deci-normal solutions it is the $\frac{1}{10}$ th part of an atom weighed in grains. The reason of this is, that 100 Decems of normal solution are equal to 1 atom of the pure chemical, so that 1 Decem indicates 1 per cent.

2683 c. When the Septem graduation is employed, the quantity of substance to be weighed out depends upon the strength of the test solutions that are to be used. When these are of 1°,—that is to say, when a Decigallon contains only 1 atom of the pure chemical weighed in grains,—then 100 Septems contain only the $\frac{1}{10}$ th part of an atom of the pure chemical, and the $\frac{1}{10}$ th part of an atom of crude substance weighed in grains is to be taken for analysis. But when the test liquors are of 5°, then 5 times as much crude substance must be taken, if it is desired that the Septems of test liquor used shall indicate *per-centages* of the substance that is to be estimated.

2683 d. The choice of the quantity of crude substance to be taken for analysis depends, however, in all these cases, partly upon another consideration,—namely, that it is frequently necessary to repeat the volumetric testing of the same substance, or to subject the substance to a variety of tests. Thus, in the testing of crude soda, it is often necessary to determine,—1st, the total alkaline strength; 2ndly, the proportion due to caustic alkali, as distinguished from carbonated alkali; 3rdly, the percentage of sulphates; 4thly, that of chlorides; 5thly, that of sulphides or hyposulphites, &c. As separate weighings of the substance for all these operations would be troublesome, it is better to weigh out at once 10 times the proper quantity of substance, to dissolve this in a Normal measure (namely, a Litre, a flask of 1000 Decems, or a Decigallon), and by means of a pipette to take successive doses of $\frac{1}{10}$ th part, or 100 measures, for the separate trials.

2683 *e.* When empirical test solutions are employed, the quantity of crude substance to be taken depends entirely upon the arbitrary standard of the test solution. You prepare, for example, a test acid of such strength, that 100 Septems of it indicate 100 grains of pure carbonate of soda. In that case, you weigh out 100 grains of crude soda, and the test solution then indicates *per-centages* of pure carbonate in the crude article. Or, on the principle explained above, and in order to have a better average, you dissolve ten hundred grains of the crude soda, in a Decigallon of solution, and you take the $\frac{1}{10}$ th part, or 100 Septems of the solution, for each Volumetric Analysis. In that manner, ten testings require only one weighing.—This subject is further discussed at No. 2912.

2683 *f.* DECIMAL WEIGHTS AND MEASURES FOUNDED ON THE EXISTING IMPERIAL STANDARDS.—We might have in Britain the advantages of a decimal system of weights and measures, without introducing the French system, and with comparatively little alteration of the Weights and Measures now in common use. The plan is, to abolish the GRAIN, and take as the basis of our decimal system a weight equal to seven Imperial grains. Names would be required for this new unit, for the measure of water corresponding to that weight, and for the measure of water corresponding to a pound weight, which latter might be called a PINT. The following table shows the relations of such Decimal Weights and Measures.

DECIMAL WEIGHTS AND MEASURES,

FOUNDED ON THE IMPERIAL GALLON AND THE AVOIRDUPOIS POUND.

WEIGHTS.					Value in Imperial Grains.
Stone ?	Pound.	Ounce.	Dram ?	Grain ?	
MEASURES.					
Gallon.	Pint ?	Gill ?		Minim ?	
1.	10.	100.	1000.	10000.	70000.
.1	1.	10.	100.	1000.	7000.
.01	.1	1.	10.	100.	700.
.001	.01	.1	1.	10.	70.
.0001	.001	.01	.1	1.	7.

1 Hundred Weight = 10 Stone. 1 Ton = 10 Hundred Weight.

The names used in the above table are subjects for consideration. One thing is clear, that it is expedient to have different names for weights and measures. But whether it is expedient to apply *old* names to *new* quantities, such as *pint* to a measure of $\frac{1}{10}$ gallon instead of $\frac{1}{8}$ gallon, and *grain* to a weight 7 times as much as it now means, is doubtful. On the other hand, comes the fact, that it is difficult for the public to learn new names, especially long Greek-looking names; in preference to doing which, they would probably prefer to attach new meanings to old names. I exhibited a copy of this Table, with a set of illustrative brass weights, at the Great Exhibition of 1851. On that occasion, I proposed for the measure of the pound of water the term Decigallon; and for the proposed unit, equal in value to 7 grains, I proposed the terms BARO for the Weight, and BARIM for the Measure. It has, I believe, been suggested by Sir John Herschell, that a suitable term for the unit of a system of weights would be MIL. In the event of the adoption of that term, the word MILIM might be used to indicate the correspondent unit of liquid measurement.

Apart from the difficulties presented by nomenclature, which apply with equal force to the French-Greek names, this proposed *decimal* system offers as many conveniences as the French system. It is equally convenient for scientific calculations; and, retaining as its bases the Imperial Gallon and the Avoirdupois Pound, it presents no obstacles to the British Commercial public, either at home, or in the Colonies and British Dependencies abroad.

APPARATUS FOR VOLUMETRIC ANALYSIS.

2684. The principal instruments required for Volumetric Analyses are the following :—

MEASURING FLASKS, used for the preparation of Normal Test Liquors, or for bringing determinate quantities of chemicals into a given volume of solution.

GRADUATED TEST MIXERS, for diluting solutions of chemicals from one known strength to another and weaker degree.

BURETTES, or finely graduated Test Tubes, for measuring the test liquors used in each analysis.

PIPETTES for measuring small quantities of solutions. These are of two kinds ; such as deliver one fixed quantity of liquor, or such as, being tubular and graduated from end to end, measure various quantities.

MIXING JARS, in which the liquor to be assayed is mixed with the test liquor.

MISCELLANEOUS APPARATUS, comprehending Supports for the instruments, Test Papers, Stirrers, Filters, &c., to which may be added the articles required for special operations, Boiling Tubes, Evaporating Basins, Small Stills and Condensers, &c.

BURETTES AND BURETTE SUPPORTS.

2685. The chief FORMS of the burette are those of Mohr, of which several modifications are shown by the Figures on page 287 ; the syphon burette of Mohr, Figs. 2732 and 2733 ; Binks's burette, Fig. 2736 ; Gay Lussac's, Fig. 2740 ; and the old alkalimeter, Fig. 2746, made either with or without a stopper. Of these forms, the most generally useful is that of Mohr, Fig. 2688 ; but this form cannot be used with certain test solutions, such as that of permanganate of potash, which is decomposed by the vulcanised caoutchouc, by which the burette is closed at the lower end : and this difficulty has given rise to the construction of other forms of the burette, which will be described under the different heads.

2686. In SIZE, burettes differ greatly. The most common capacities contain 50 centimetre cubes, or nearly 770 grains of water ; or 100 septems, equal to 700 grains of water ; or 100 deccms, equal to 1000 grains of water. But many other sizes are required for special operations ; and latterly, burettes of small size have been much used, such as those containing 20 centimetre cubes divided into $\frac{1}{10}$ ths, 25 or 50 septems divided into $\frac{1}{10}$ ths, and the like. Whatever the capacity of the instrument, the length of the scale upon it ought not to exceed 15 or 16 inches ; otherwise the instrument is inconvenient in use. When the burette is fixed in its stand, as represented by the Figures on page 287, you ought to be able to read the line of 0° at the top of the scale, and the lowest number at the bottom, without being forced to climb on a stool, or to go down on your knees.

2687. The GRADUATION of the burette is usually into centimetre cubes, septems, or decems, or each of these units into halves, fifths, or tenths. It is frequently recommended, that the instrument should contain exactly 100 degrees or marks on the scale. But 100 measures is rarely necessary to be used in any analytical operation ; while for technical assays it is often preferable to have a scale with another limit, namely, a less number of degrees than 100, and these divided into fifths or tenths, to permit of the ready determination of fractions. The facility for the exact reading of the scales on burettes that is afforded by the use of Erdmann's float, No. 2728, recommends the use of close graduation, which, with the assistance of delicate pipettes, makes it easy to perform analyses with much smaller quantities of solutions than were formerly used, when graduated instruments were made with little pretension to accuracy or convenience. There is, however, a limit to closeness of graduation ; for if the lines are set closer than 20 to the inch, they are not easy to read. The reading of even millimetre scales, which are 25 to the inch, almost requires the use of a cathetometer (No. 2383,) which is not a convenient adjunct to an alkalimeter.

2688. MOHR'S BURETTE, WITH PINCHCOCK, JET, AND CAOUTCHOUC TUBE. Fig. 2688, *a, c, d*, page 287.

Mohr's burette is represented by Fig. 2688. *a* is a cylindrical tube, which carries the graduated scale, 0° being at the top, and 100° at the bottom. The tube is open at both ends ; but the lower end is contracted, and is connected by a short flexible tube of vulcanised caoutchouc with a small glass jet *c*. Across the flexible tube is placed a pinchcock *d*, which closes the tube when left at rest, and opens it when the buttons at *d* are slightly pressed with the finger and thumb. It is easy either to let out a continuous stream of the test liquor, or to limit its passage to single drops. The burette is represented as suspended by a ring of cork or caoutchouc from the upper arm of the support *eb*. The lower arm *fb* serves principally to keep the burette in an upright position. The point *c* is fixed at such a height above the table as to allow free motion to the mixing jar *g*, which is placed below the jet, with the liquid that is to be tested. Various forms of the pinchcock are shown at Nos. 2715-21.

2688. MOHR'S BURETTE, WITH PINCHCOCK, CAOUTCHOUC TUBE, AND JET. Fig. 2688.

Graduated into Centimetre Cubes.

1	10 CC. in $\frac{1}{10}$	3s.
2	25 „ $\frac{1}{2}$	2s. 9d.
3	25 „ $\frac{1}{5}$	3s.
4	25 „ $\frac{1}{10}$	4s.
5	35 „ $\frac{1}{5}$	4s.
6	35 „ $\frac{1}{10}$	4s. 6d.
7	55 „ $\frac{1}{2}$	4s. 9d.
8	55 „ $\frac{1}{5}$	5s.
9	55 „ $\frac{1}{10}$	5s. 9d.
10	60 „ $\frac{1}{10}$	6s.
11	75 „ $\frac{1}{2}$	5s. 6d.
12	75 „ $\frac{1}{5}$	6s.
13	75 „ $\frac{1}{10}$	7s.
14	100 „ $\frac{1}{1}$	6s.
15	100 „ $\frac{1}{2}$	6s. 6d.
16	100 „ $\frac{1}{5}$	8s.
17	150 „ $\frac{1}{3}$	12s.
18	200 „ $\frac{1}{1}$	7s.
19	200 „ $\frac{1}{2}$	8s.

Graduated into Septems.

20	10 septems in $\frac{1}{10}$	2s. 6d.
21	25 „ $\frac{1}{5}$	2s. 6d.
22	35 „ $\frac{1}{5}$	3s.
23	35 „ $\frac{1}{10}$	4s.

Graduated into Septems.

24	55 septems in $\frac{1}{1}$	3s.
25	55 „ $\frac{1}{5}$	4s.
26	55 „ $\frac{1}{10}$	5s.
27	70 „ $\frac{1}{1}$	4s.
28	70 „ $\frac{1}{2}$	4s. 6d.
29	70 „ $\frac{1}{5}$	5s.
30	100 „ $\frac{1}{1}$	4s. 6d.
31	100 „ $\frac{1}{2}$	5s.
32	100 „ $\frac{1}{5}$	6s.
33	200 „ $\frac{1}{1}$	6s.

Graduated into Decems.

34	10 decems in $\frac{1}{10}$	2s. 9d.
35	25 „ $\frac{1}{5}$	3s.
36	35 „ $\frac{1}{5}$	3s. 6d.
37	35 „ $\frac{1}{10}$	4s.
38	55 „ $\frac{1}{2}$	4s.
39	55 „ $\frac{1}{5}$	4s. 6d.
40	55 „ $\frac{1}{10}$	5s.
41	70 „ $\frac{1}{2}$	4s. 6d.
42	70 „ $\frac{1}{5}$	5s. 6d.
43	100 „ $\frac{1}{1}$	5s.
44	100 „ $\frac{1}{2}$	6s.
45	100 „ $\frac{1}{5}$	7s. 6d.
46	200 „ $\frac{1}{1}$	7s.

Special Gradations.—47 100 grains in 100° marked 0 to 100 3s.
 48 1000 „ 200° „ 0 to 200 6s.
 49 100 minims in 100° 3s. 6d.
 50 200 „ 200° 4s. 6d.

2689. MOHR'S BURETTE, with GLASS STOPCOCK. Fig. 2690, page 287.

When Mohr's burette requires to be used with a solution of permanganate of potash, or of iodine, or any other test which acts upon sulphur or caoutchouc, the flexible tube cannot be used, because it spoils the test. To meet this difficulty, burettes have been made with a glass stopcock, as represented in Fig. 2690. This apparatus, however, is not so convenient in use as the former kind, the stopcock being more difficult to manage than the pinchcock, and requiring great care to limit the delivery of the liquor to small drops.

Graduated into Centimetre Cubes.

1.	10 CC. in $\frac{1}{10}$	4s.
2.	25 „ $\frac{1}{5}$	5s.
3.	25 „ $\frac{1}{10}$	5s. 6d.
4.	60 „ $\frac{1}{2}$	6s. 6d.
5.	60 „ $\frac{1}{5}$	7s.
6.	60 „ $\frac{1}{10}$	8s.
7.	75 „ $\frac{1}{2}$	7s. 6d.
8.	75 „ $\frac{1}{5}$	8s. 6d.
9.	100 „ $\frac{1}{2}$	8s.
10.	100 „ $\frac{1}{5}$	10s.
11.	200 „ $\frac{1}{1}$	9s.

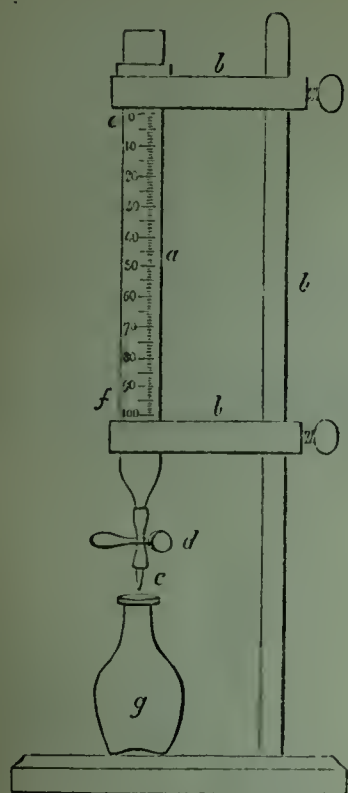
Graduated into Septems.

12.	25 septems in $\frac{1}{5}$	4s. 6d.
13.	55 „ $\frac{1}{5}$	5s. 6d.
14.	100 „ $\frac{1}{1}$	6s. 6d.
15.	100 „ $\frac{1}{5}$	7s. 6d.

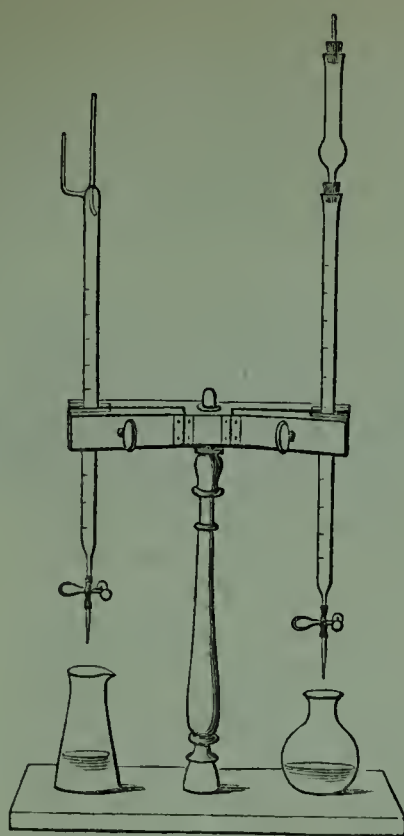
Graduated into Decems.

16.	50 decems in $\frac{1}{2}$	6s.
17.	100 „ $\frac{1}{1}$	7s.

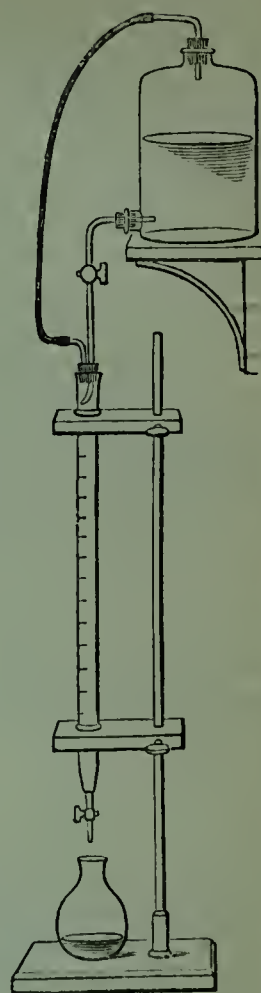
2690. Mohr's Burette, with Glass Stopcock, and Apparatus for Supporting and Filling the Burette, and for preserving the test liquor. Fig. 2690, page 287, 25s.



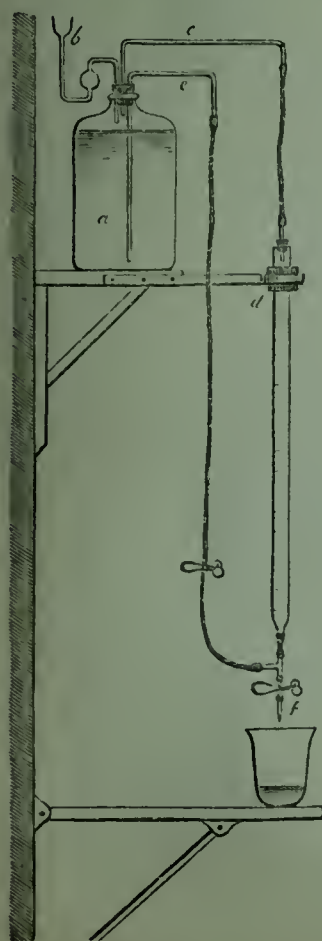
2688.



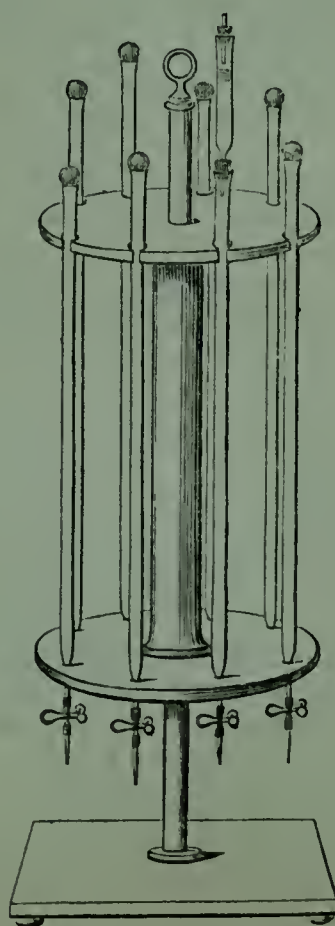
2698.



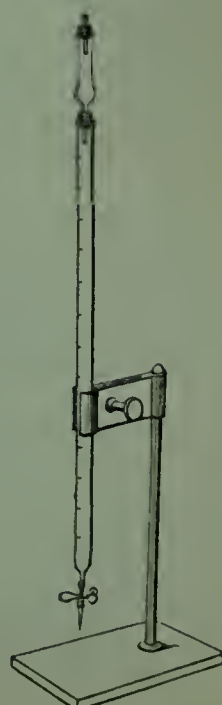
2690.



2693.



2709.



2708.

This apparatus consists of a burette, with glass stopcock, and apparatus for supporting it, and for supplying the test solution without contact with flexible tubes. The flask which contains the test solution is of 8 pints capacity. It is connected with the burette by a glass tube, having a stopcock in the middle, (see No. 2691). This tube is bent, as represented in Fig. 2690, in such a manner as to throw the test liquor against the inner side of the burette, and cause it to descend without producing froth. A flexible tube, that does not come into contact with the liquor, conveys air from the burette to the flask. To fill the burette, the lower stopcock is closed, and the upper one is opened. When it is full, the upper one is closed, and the lower one is used to regulate the outflow of the test liquor. The burette is thus easily filled without waste of the test liquor, and without unnecessary contact with atmospheric air. The flask that contains the test solution is provided with a bent safety funnel, like *b*, Fig. 2693, and mounted in the same way. This is not shown in Fig. 2690.

2691. Glass Tube, with Stopcock, for use in constructing apparatus of the character of 2690.

The tube 12 inches long, Fig. 2691, 2s. 6d.

2692. ARRANGEMENT FOR FILLING MOHR'S BURETTE WITH TEST LIQUOR FROM BELOW, to prevent the interference of air bubbles, as represented by Fig. 2693, page 287, consisting of the pieces represented in Fig. 2692, namely, the tee-piece *b*, one extra pinchcock, *g*, and two short caoutchouc tubes, *d* and *e*. The set, 1s. 6d.

Fig. 2693, page 287, shows the method of mounting Mohr's Burette near a window, where it can be filled with test liquor in an easy and rapid manner. *d* is the burette; *f* the arrangement shown in detail by Fig. 2692; *a*, Fig. 2693, is the bottle of test liquor, placed on a high shelf; *b*, a funnel to permit access of air; *e*, syphon by which the liquor descends to the burette; *c*, tube by which air passes from the burette *d* into the bottle *a*. The burette is filled by opening the pinchcock placed on the caoutchouc part of the tube *e* in Fig. 2693, or *f*, Fig. 2692. When the test liquor is let off by the jet, the burette is supplied with air through the funnel tube *b* and the syphon *c*. The test liquor rises quietly in the burette without producing bubbles or foam, and without free contact with atmospheric air.

The burette can be supplied in this manner from a store bottle placed at a lower level, by means of the apparatus described at No. 2825.

WOODEN SUPPORTS FOR MOHR'S BURETTE, form of Fig. 2688, *b, b, b*, page 287. The burette is supported on the upper arm by a ring of cork or vulcanised caoutchouc. The lower arm serves to keep the burette steady, when the hand is applied to the pinchcock. The following four varieties:—

FOR ONE BURETTE.

2694 *a*. White Wood, 3s. 6d.

2694 *b*. Mahogany, 5s.

FOR TWO BURETTES.

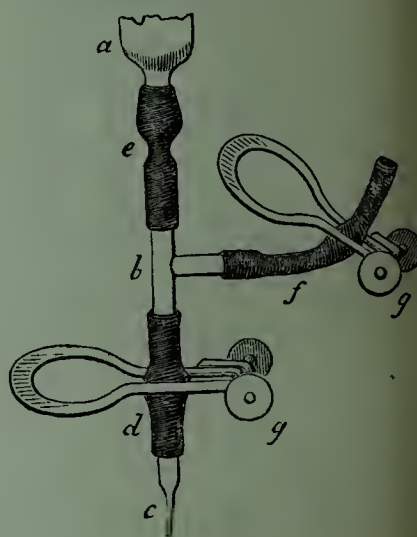
2695 *a*. White Wood, 5s.

2695 *b*. Mahogany, 6s. 6d.

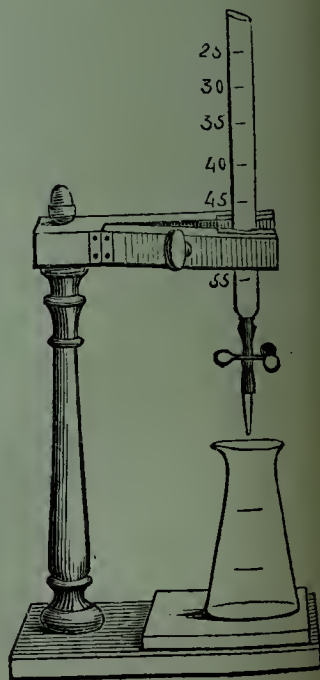
2697. WOODEN CLAMP SUPPORT FOR MOHR'S BURETTE, with hinges and screws, which permit of the easy mounting or removal of the burettes, and their ready adjustment, higher or lower, to suit different sizes of jars that are to be placed below them. The double support is represented by Fig. 2698, page 287, and the single support by Fig. 2697.



2691.



2692.



2697.

WOODEN SCREW CLAMPS FOR MOHR'S BURETTE, FIGS. 2697, 2698.

For One Burette.

2697 Black Wood, 4s.

2697 *a.* Mahogany, 5s. 6d.

For Two Burettes.

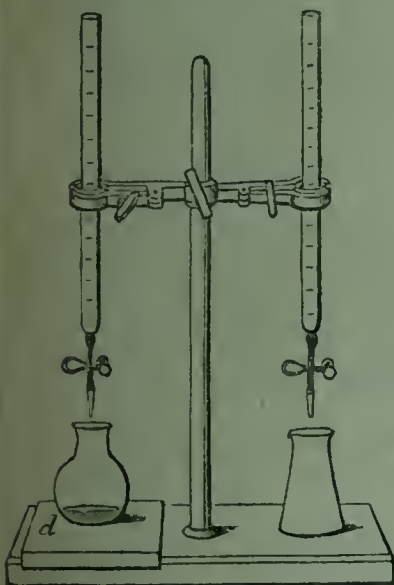
2698 Black Wood, 5s. 6d.

2698 *a.* Mahogany, 7s. 6d.

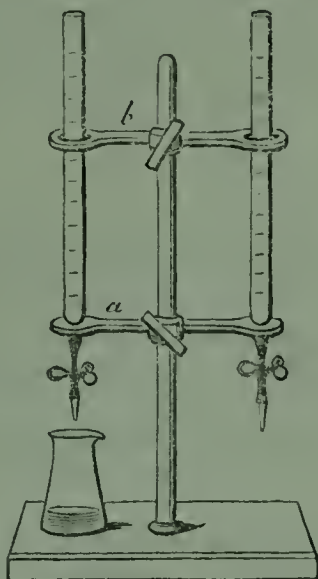
2700. IRON CLAMP SUPPORT FOR ONE MOHR'S BURETTE, consisting of an iron clamp lined with cork, and regulated by a screw, attached to a collar with thumb screw, which slides upon an iron rod, 24 inches by $\frac{1}{2}$ inch, rising from an iron base $7\frac{1}{2}$ inches by $4\frac{1}{2}$ inches. Similar to Fig. 2701, *but for only one burette*, 6s. 6d.

2701. IRON CLAMP SUPPORT FOR A PAIR OF MOHR'S BURETTES, Fig. 2701. Similar to No. 2700, but the iron base 14 inches long, and $5\frac{1}{2}$ inches wide; the rod 24 inches by $\frac{1}{2}$ inch, with branches for two burettes, 10s. 6d.

The advantage of this form of support is, that the burette can be readily set up or taken down without removing the pinchcock, or can have its delivery jet easily fixed at any required distance from the table, to accommodate the size of the mixing jar that is to be used in any given operation. It is very handy when the burette requires to be frequently changed, or frequently washed, for use with a new solution.



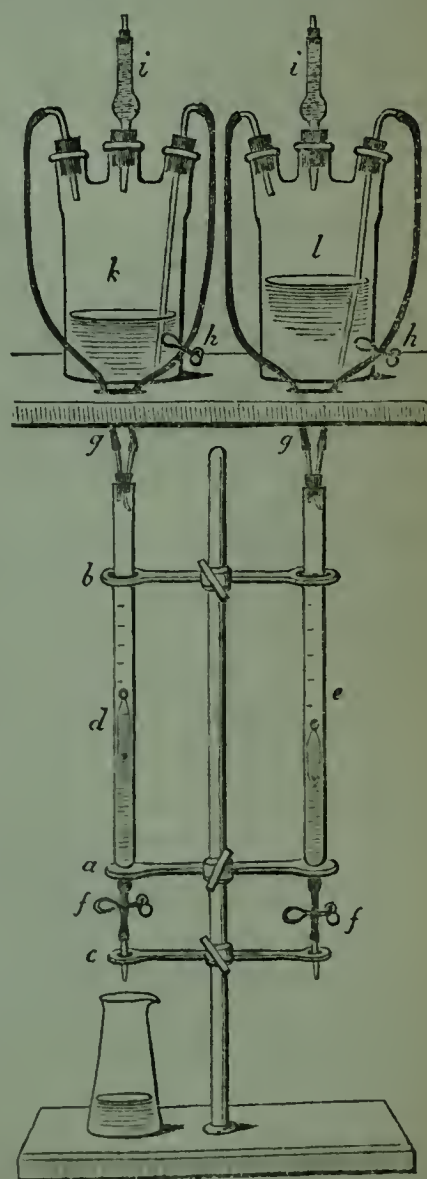
2701.



2703.

2702. SUPPORT FOR MOHR'S BURETTE, form of Fig. 2703, *but for a single Burette*; consisting of an iron rod 24 inches by $\frac{3}{8}$ inch, fixed on an iron foot of $7\frac{1}{2}$ inches by $4\frac{1}{2}$ inches, with two brass branches; one of which, *a*, serves to support the burette, and the other, *b*, to keep it upright, 3s. 6d.

2703. SUPPORT FOR A PAIR OF MOHR'S BURETTES, constructed on the plan described at No. 2702, but for two burettes as represented in Fig. 2703, iron foot 14 inches by $5\frac{1}{2}$ inches, iron rod 24 inches by $\frac{3}{8}$ inch, with two brass branches, 5s. 6d.



2704.

If the holes in the branches *a* and *b* are too large for a given burette, they can be reduced in aperture by twisting some cord round them. The apparatus Fig. 2704 is similar to this, but has the additional branch *c*, to steady the jets.

2704. SUPPORT FOR A PAIR OF MOHR'S BURETTES, *with triple branches*, as represented by Fig. 2704. The iron rod measures 24 inches by $\frac{3}{8}$ inch; the iron base 14 inches by $5\frac{1}{2}$ inches; the three branches are of brass: the branch *a* supports the burettes; *b* keeps them upright; and *c* serves to prevent the twisting of the jets when the pinchcocks *f* are pressed. 6s. 6d.

2704 *a*. The Figure 2704 represents a pair of burettes mounted on a support like No. 2704 and placed in connexion with two reservoirs of test liquors, mounted on a shelf; the solution in the bottle *k* for example, consisting of caustic potash, and that in *l* of sulphuric acid, both of the same strength. These bottles are supposed to be placed on a shelf near a window, before which the burette frame is fixed. By opening the stopcocks *h*, the burettes are filled, air passing from the burettes to the store bottles by the tubes *g*. When necessary, air goes into the bottles by the tubes *i i*, depositing its carbonic acid on the substances placed in those tubes, (see No. 2823). The branch *c* keeps the delivering jets in proper position over the mixing jars when the pinchcocks *f f* are pressed.

This figure is given as an illustration of the method of mounting apparatus of this description for technical use. In a chemical manufactory many different bottles of tests may be necessary, and the size of the bottles and mode of supporting them must depend upon the requirements of the manufactory and the conveniences of the laboratory. In some places it may be necessary to place the bottles of test solutions *k* and *l* in a lock-up cupboard, tubes of glass and caoutchouc proceeding thence towards the burette stand. Generally speaking, the stock test liquors should be kept in the dark, and always as nearly as possible at the temperature of 62° Fahr. The narrow tubes which lead from the stock bottles to the burettes ought not to be needlessly exposed to sunshine.

2705. SUPPORT FOR ONE MOHR'S BURETTE, on the plan represented by Fig. 2704, with three branches. The iron base measures $7\frac{1}{2}$ by $4\frac{1}{2}$ inches; the iron rod 24 inches by $\frac{3}{8}$ inch; the three branches of brass, 4s. 6d.

2706. Iron Support for Mohr's Burette, rectangular iron foot, $7\frac{1}{2}$ by $4\frac{1}{2}$ inches, iron rod, 26 inches by $\frac{3}{8}$ inch, with two brass clips to hold the burette, 6s. 6d.

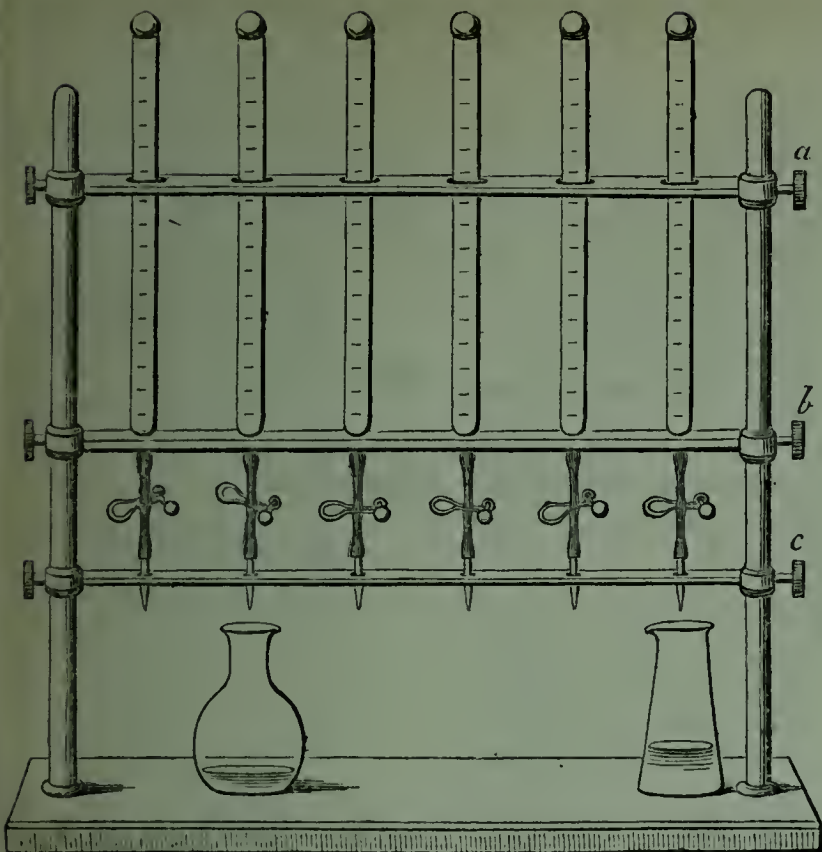
2707. Brass Support for Mohr's Burette, rectangular iron foot, $7\frac{1}{2}$ by $4\frac{1}{2}$ inches, 26-inch polished brass rod, with two strong brass clips to hold the burette, 8s.

2708. Support for Mohr's Burette, consisting of a broad brass clamp, sliding on an iron rod, which is fixed to a square iron base, $7\frac{1}{2}$ inches by 4 inches. Fig. 2708, page 287, 4s.

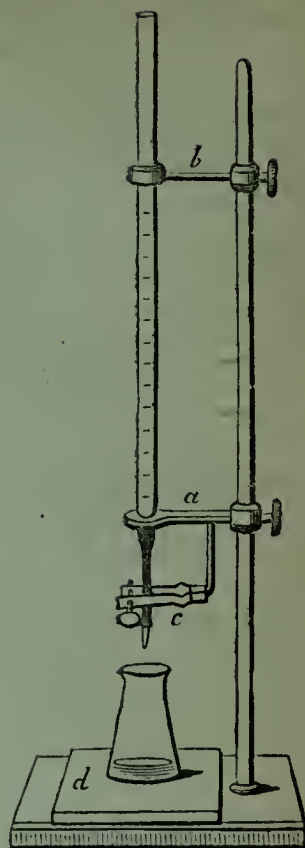
2709. MOHR'S REVOLVING SUPPORT for 8 Burettes. Represented by Fig. 2709, page 287, excepting that the base is round, and 12 inches in diameter. The burettes are fixed at a suitable height from the base for convenient use, but there is a screw to adjust that height. The scales can be read without removing the burettes from the support. Polished Black Wood, 12s. 6d.

2710. Support for six Burettes, to stand in a row before a window, with triple branches, as represented by Fig. 2710. The branch *b* serves to support the burettes, *a* to keep them upright, and *c* to steady the jets. Length of the base, $32\frac{1}{2}$ inches; width, 6 inches. The upright rods are 24 inches long, and $\frac{1}{4}$ inch in diameter. These and the base are made of iron. The three branches are made of gun metal. The jets are fixed $3\frac{1}{2}$ inches apart. The burettes being supported by the middle bar *b*, can be fixed at any required height above the base. Price 15s.

The burettes are represented in Fig. 2710 as closed at the upper end by stone marbles, as recommended by Mohr. It seems scarcely necessary to explain that the burettes can, if requisite be easily connected with store bottles of test solutions by any of the methods shown by Figs. 2690, 2693, or 2704, the bottles being placed on a shelf, or, for safety, in a lock-up press.



2710.



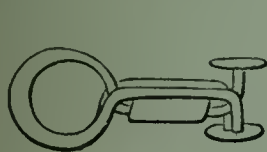
2711.

2711. MOHR'S BURETTE, mounted on a Support with Brass Arms according to Dr. PERCY, for use in the Volumetric Analysis of Ores of Zinc, Copper, &c. Fig. 2711, 18s.

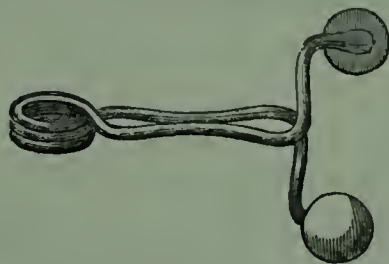
a. The Burette alone, 6s.

b. The Support alone, 12s.

The graduation of the burette is 1,000 grains in 200° marked 0° to 200° . The support is an iron rod of 24 inches by $\frac{3}{8}$ inch; an iron foot $7\frac{1}{2}$ inches by $5\frac{1}{2}$ inches; two bronzed brass arms for holding the burette; and a special arm for the pinchcock, which is made with a screw, by which the issue of the test solution in single drops can be easily regulated. See PERCY's *Metallurgy*.



2718.



2719.



2720.

PINCHCOCKS FOR MOHR'S BURETTES.

2715. Mohr's Pinchcock, the Original Form, *g*, Fig. 2692, page 288, the usual size for Burettes, namely, about twice the size of the figure, 4d.

2716. Ditto, small size, 3d.

2717. Ditto, large size, 6d.

2718. Pinchcock, extra strong, for stout tubes, form of Fig. 2718, 6d.

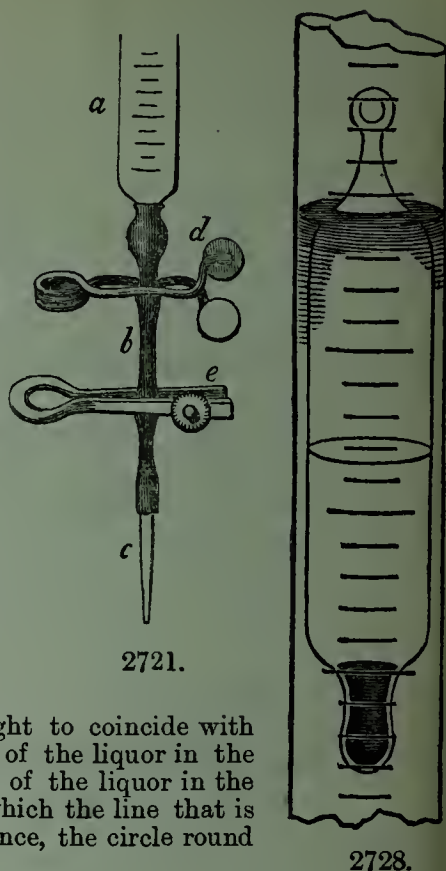
2719. Hart's Pinchcock, steel wire, form of Fig. 2719, very light, strong, and elastic, 3d.

2720. Pinchcock with a screw, for producing a regular flow of uniform drops
Fig. 2720, page 291, 6d.

2721. This last pinchcock is fixed for use on a flexible tube *below*, one of the other pinchcocks. It is adjusted, by means of the screw, to give drops of a required size. The other pinchcock serves to admit or to cut off the supply of liquor. This limits the supply to drops. The method of applying the two pinchcocks is shown by Fig. 2721. An apparatus of this sort is useful in the assay of silver coin, and in other cases, when drops of test of determined size and value are required to be given with absolute precision. The clamp *e* is screwed up to the requisite size, and then left open. The pinchcock *d* is only opened when the drops are wanted.

2728. ERDMANN'S FLOAT, for facilitating the correct reading of the scale engraved on Mohr's Burette. Fig. 2728, 1s. 6d.

This float is represented by Fig. 2728, as floating in liquor in a burette. It ought to float upright, and not lean against the side of the burette. It is made about the size of the figure. It must be of such a width as nearly to fill the burette, but yet so loosely as to float freely up and down with the liquor. To set the instrument at zero (0°), the liquor, first filled a little above the mark, is to be run out of the burette until the ring that is cut round the float is brought to coincide with the line of 0° engraved on the burette. The absolute height of the liquor in the burette is to be disregarded. To read the measurable height of the liquor in the burette at any time, is to note that degree on the scale with which the line that is cut round the float coincides. When observing this coincidence, the circle round the float must appear to the eye like a straight line.



2729. RAMMELSBERG'S BURETTE, a variety of Mohr's Burette; with the addition of a tube to bring the test liquor from its reservoir and deliver it against the inner side of the burette, so as to avoid frothing, and a second tube to carry away atmospheric air from the burette. Fig. 2698, page 287, *the burette on the left hand*, and B, Fig. 2730, with caoutchouc tube, pinchcock, and jet:—

1.	25 Centimetre Cubes, in $\frac{1}{10}$ CC.	4s.
2.	55 " $\frac{1}{2}$	5s. 6d.
3.	55 " $\frac{1}{5}$	6s.
4.	75 " $\frac{1}{2}$	6s.
5.	75 " $\frac{1}{5}$	7s.
6.	100 " $\frac{1}{1}$	6s.
7.	100 Septems in $\frac{1}{1}$ S.	5s.
8.	100 Decems in $\frac{1}{1}$ D.	5s. 6d.

2730. MAHOGANY SUPPORT to fix Rammelsberg's Burette against a wall, or a window post, Gay-Lussac's pattern, as used for his silver test. Fig. 2730 *a, b, c*, 5s.

The method of mounting Rammelsberg's Burette, in connexion with a reservoir of test liquor, is shown by Figs. 2690 and 2693, either of which plans may be adopted. In chemical manufacturing, where the same volumetric test is to be applied frequently and every day, it is extremely convenient to have the burette always at hand and filled, ready for immediate use.

Rammelsberg's Burette being a close instrument, does not admit the use of Erdmann float. In that respect, the instruments shown in Figs. 2690 and 2693 are preferable for delicate processes.

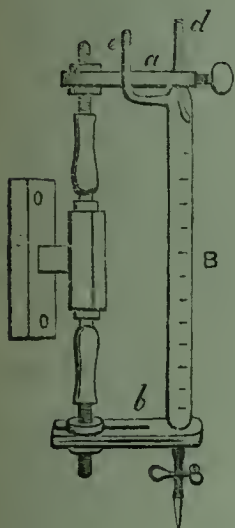
2731. MOHR'S SYPHON BURETTE, for use with permanganate of potash, two sorts :
Fig. 2732 with blowing tube, and Fig. 2733 with caoutchouc ball for blowing.

The prices in the following list are for the Burette with one glass blowing tube and two syphon jets, but without support and caoutchouc fittings :—

2732. The above, with caoutchouc blowing tube, Fig. 2732, 6d. extra.

2733. The above, with caoutchouc blowing ball, Fig. 2733, 1s. extra.

2734. Mahogany Foot for the Syphon Burette, as represented in the Figures, loaded with lead, 1s. 6d.



2730.



2732.



2733.



2736.

Graduated into Centimetre Cubes.

1.	25 cc. in $\frac{1}{10}$ cc.	3s.
2.	25 cc. in $\frac{1}{10}$ cc.	3s. 3d.
3.	35 cc. in $\frac{1}{10}$ cc.	3s. 6d.
4.	35 cc. in $\frac{1}{10}$ cc.	4s.
5.	55 cc. in $\frac{1}{2}$ cc.	4s.
6.	55 cc. in $\frac{1}{2}$ cc.	4s. 6d.
7.	55 cc. in $\frac{1}{10}$ cc.	5s.
8.	75 cc. in $\frac{1}{10}$ cc.	6s.
9.	100 cc. in $\frac{1}{10}$ cc.	5s.
10.	100 cc. in $\frac{1}{2}$ cc.	6s.
11.	100 cc. in $\frac{1}{10}$ cc.	8s.

Graduated into Septems.

12.	55 Septems in $\frac{1}{2}$	4s. 6d.
13.	100 Septems in $\frac{1}{2}$	6s.
14.	100 Septems in $\frac{1}{2}$	7s.

Graduated into Decems.

15.	60 Decems in $\frac{1}{2}$	4s.
16.	60 Decems in $\frac{1}{2}$	5s.
17.	100 Decems in $\frac{1}{2}$	6s. 6d.

2736. BINKS'S BURETTE, form of Fig. 2736. [List of Sizes on page 294.]

This is not so convenient an instrument as Mohr's Burette, but it can be used with any kind test, and is less fragile than the Syphon Burette, or than Gay-Lussac's Burette. The solutions are liable to run down outside the spout *a*, but can, in most cases, be prevented by applying a little stiff tallow to the spout, and boring through it a small hole with a needle. To manage this instrument properly, it must be held near the top, the thumb being placed above the scale. If it is held lower down, the delivery of single drops is difficult.

2736. BINKS'S BURETTE, FIG. 2736, (See note on page 293).

Graduated into Centimetre Cubes.

1.	10 cc. in $\frac{1}{2}$	2s. 6d.
2.	10 cc. in $\frac{1}{3}$	2s. 9d.
3.	10 cc. in $\frac{1}{10}$	3s.
4.	25 cc. in $\frac{1}{2}$	3s. 3d.
5.	25 cc. in $\frac{1}{3}$	3s. 6d.
6.	25 cc. in $\frac{1}{10}$	3s. 9d.
7.	35 cc. in $\frac{1}{2}$	4s.
8.	35 cc. in $\frac{1}{10}$	4s. 6d.
9.	50 cc. in $\frac{1}{2}$	5s.
10.	50 cc. in $\frac{1}{3}$	5s. 6d.
11.	50 cc. in $\frac{1}{10}$	6s.
12.	70 cc. in $\frac{1}{2}$	6s.
13.	100 cc. in $\frac{1}{2}$	6s.
14.	100 cc. in $\frac{1}{3}$	6s. 6d.
15.	100 cc. in $\frac{1}{10}$	8s.
16.	200 cc. in $\frac{1}{2}$	8s.

Graduated into Septems.

17.	25 Septems in $\frac{1}{2}$	2s.
18.	25 „ in $\frac{1}{3}$	2s. 6d.
19.	35 „ in $\frac{1}{2}$	3s.

Graduated into Septems.

20.	55 Septems in $\frac{1}{2}$	3s.
21.	55 „ in $\frac{1}{3}$	4s. 6d.
22.	55 „ in $\frac{1}{10}$	5s.
23.	70 „ in $\frac{1}{2}$	3s. 6d.
24.	70 „ in $\frac{1}{3}$	5s.
25.	100 „ in $\frac{1}{2}$	4s. 6d.
26.	100 „ in $\frac{1}{3}$	6s.

Graduated into Decems.

27.	50 Decems in $\frac{1}{2}$	5s.
28.	50 „ in $\frac{1}{3}$	6s.
29.	100 „ in $\frac{1}{2}$	5s.
30.	100 „ in $\frac{1}{3}$	6s. 6d.
31.	100 „ in $\frac{1}{10}$	8s.

Special Graduations.

32.	32 Clark's Test Measures in $\frac{1}{2}$	4s.
33.	16 — Test Measures in $\frac{1}{3}$	3s. 6d.
34.	500 Grains in 250°	4s. 6d.
35.	1000 „ in 200°	6s. 6d.
36.	100° after Descroizilles	4s.

The block and screen, No. 2743, described as being necessary to the correct reading of the height of liquid in Gay-Lussac's Burette, is equally necessary for use with Binks's Burette.

2737. FOOT FOR BINKS'S BURETTE, Fig. 2738, stained wood, small size, slight. 8d.

2738. FOOT FOR BINKS'S BURETTE, Fig. 2738, large size, mahogany, loaded with lead. 1s. 6d.

2739. BINKS'S BURETTE with Foot, in one piece of Glass, stout, for the use of workmen:—

1. 100 Septems in $\frac{1}{2}$ 4s.
2. 100 Decems in $\frac{1}{2}$ 4s.
3. 50 Centimetre Cubes in $\frac{1}{2}$ 4s.
- 4: Burette for Testing Ammonia in Gas Liquors. 100 Septems in 16° each in $\frac{1}{2}$ °. 5s.

TESTING OF AMMONIA IN GAS LIQUOR.—The instrument No. 4 is used at gas works to estimate the value of ammonia liquor, according to the number of ounces of oil of vitriol which saturate one gallon. The acid is formed by diluting with water 2 ounces by weight of oil of vitriol to a pint of test acid. 100 Septems of ammonia liquor being acted upon, the number of degrees of test acid used to neutralize it according to the scale, shows the ounces of oil of vitriol per gallon. Blue litmus paper is used as the indicator. See No. 2807.

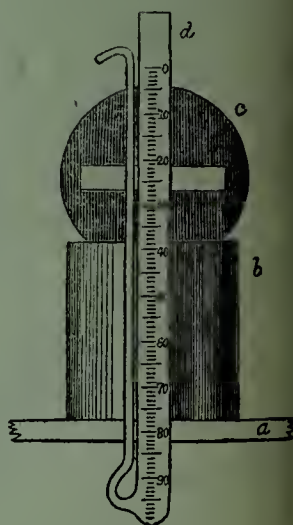
This method of testing indicates only the free ammonia. What is combined with an acid is not recognised. A more accurate process consists in mixing the gas liquor with milk of lime, distilling it in the apparatus No. 2867, receiving the ammonia as a flask containing water, and testing this distillate, which contains, not only the free ammonia of the gas liquor, but that which is liberated by the lime.



2738.



2739.

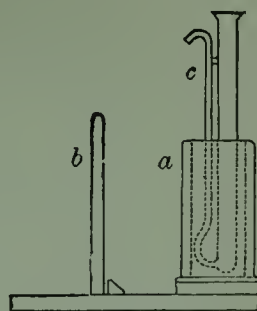


2740.

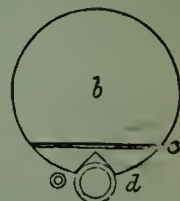
2740. GAY-LUSSAC'S BURETTE, Fig. 2740 *d*, consisting of a graduated tube, with an external tube and spout for decanting and dropping the test liquors.

This Burette, like that of Binks, can be used with test liquors of all descriptions, including the permanganate of potash. It is, however, less convenient than Mohr's form of Burette, and is easily broken. It can be used with a blowing tube, adapted to the wide end by a cork in the same manner as the blowing tube of Fig. 2732.

1.	20 Centimetre Cubes	in $\frac{1}{2}$	3s.
2.	20	„ „ in $\frac{1}{10}$	3s. 6d.
3.	50	„ „ in $\frac{1}{2}$	5s.
4.	50	„ „ in $\frac{1}{5}$	6s.
5.	50	„ „ in $\frac{1}{10}$	7s.
6.	100	„ „ in $\frac{1}{2}$	6s. 6d.
7.	200	„ „ in $\frac{1}{1}$	9s.
8.	50 Septems	in $\frac{1}{1}$	3s. 6d.
9.	100	„ in $\frac{1}{1}$	4s.
10.	50 Decems	in $\frac{1}{1}$	3s. 6d.
11.	100	„ in $\frac{1}{1}$	5s.



2741.



2743.

If fitted with a Caoutchouc Blowing Tube, each 9d. extra. If with a Ball, 1s. 3d. extra.

2741. BLACK WOOD SUPPORT for Gay-Lussac's Burette, having a space to hold it upright and a peg on which it can drain, Fig. 2741, 2s.

2742. Round Support, form of Fig. 2738, having a slit cut out for the egress of the narrow tube, mahogany, 1s. 6d.

2743. BLOCK AND SCREEN for placing Gay-Lussac's Pouret in a vertical position, and to assist the correct reading of the level of the liquid in the tube, *b*, *c*, Figs. 2740 and 2743, 1s. 6d.

The block *b*, represented vertically in Fig. 2740, and horizontally in Fig. 2743, is placed upright on a table against a window. The screen *c*, which consists of tin-plate with a window of tissue paper, is fixed upright in a slit in the block. The Burette is held by the thumb in the triangular vertical slit of the block, at such a level as to bring the surface of the solutions level with the paper screen. The black curve, which shows the height of the liquor, can thus be seen distinctly.

2744. Japanned Tin Case for Gay-Lussac's Burette, 6d. to 1s.

2746. ALKALIMETER ON FOOT, with a grooved stopper, to control the delivery of the Test Acid, form of Fig. 2746, page 296.

This form of instrument does not afford very accurate results, in consequence of the comparative clumsiness of the delivering spout; but the instrument is strong, and is commonly given to workmen, for use where only approximate results are required.

Figs. 2746 *a* and 2746 *b* are forms of Alkalimeter which are now obsolete. They were made like 2746, but without stoppers, and when in use were closed by the thumb, from the end of which the test liquor was allowed to trickle. Such instruments are probably now in use only in those establishments where chemical operations of all kinds are performed by the Rule of Thumb, if any such establishments still happen to exist.

Graduation of Instruments of the form of Figure 2746.

1.	100 Septems	in $\frac{1}{1} = 100^\circ$	3s.
2.	50 Centimetre Cubes	in $\frac{1}{2} = 100^\circ$	3s.
3.	100	„ in 100°	3s. 6d.
4.	100 Decems	in $\frac{1}{1} = 100^\circ$	3s.
5.	2 ounces of Water	in 100°	3s.

ALKALIMETERS for use with WEIGHED TEST LIQUORS. Two kinds, Schuster's and Mohr's, Figs. 2747 and 2748.

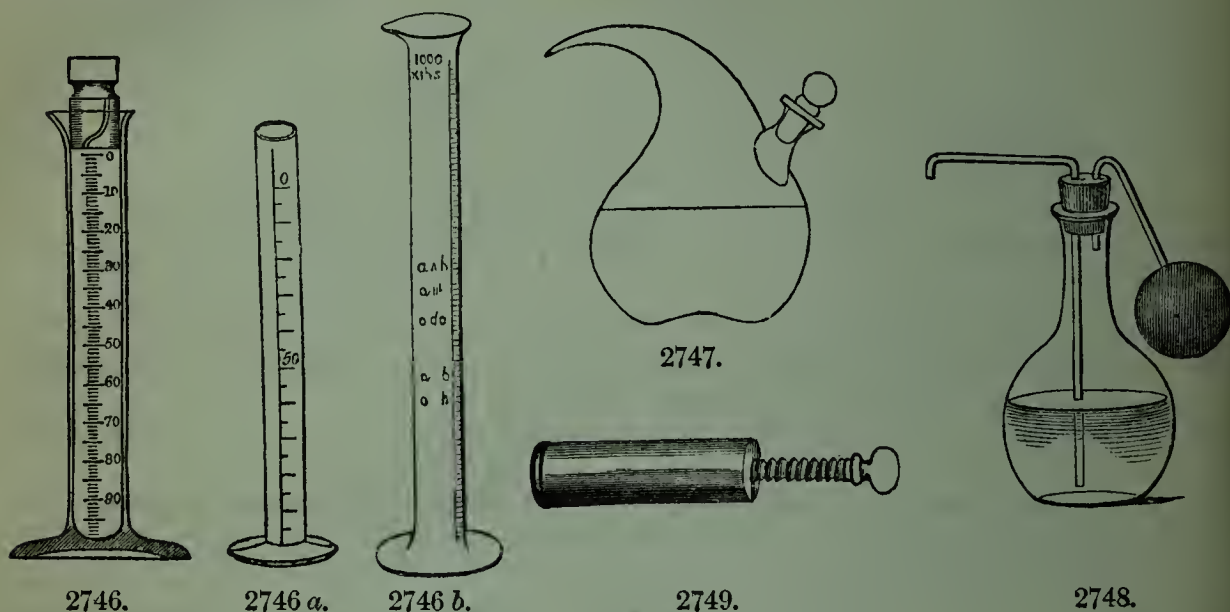
2747. SCHUSTER'S ALKALIMETER, Fig. 2747, 9d.

A very light stoppered glass bottle, of about 2 ounces capacity, in which the Normal Test Acid is weighed, then slowly dropped from a fine orifice until a given weight of Alkali is neutralized. The residual acid is again weighed, and the value of the Alkali is determined from the quantity of Acid used.

2748. MOHR'S ALKALIMETER, Fig. 2748, 10-ounce capacity, with syphon delivery tube, and Caoutchouc blowing ball, 2s. 6d.

2749. Tallow Holder, useful for greasing the mouths of burettes, 1s.

Some test liquors are apt to overflow the spouts of burettes, and the liquor escapes unreckoned, or it forms large and inconvenient drops. To prevent this source of error, the outside of the spouts should be rubbed with a little stiff tallow, and a small hole should be bored through the tallow with a fine needle. The escaping liquor then makes smaller drops, and generally loses the tendency to spread over the outside of the vessels.



PIPETTES.

2760. Graduated pipettes are instruments for transferring specific quantities of liquors from vessel to vessel. They are of two kinds; first, those which have a bulb, either spherical or cylindrical, and *one mark* on the neck above the bulb, as is represented by Figs. 2768, *a, b, c, d, e*. These serve individually for the accurate measurement and delivery of one specific quantity of a liquid, such as 5, 10, or 100 Septems, or Decems, or Centimetre Cubes. The second kind of pipettes is represented by Figs. 2769, *a, b, c, d*. It consists of a narrow cylinder, or tube, *with a scale drawn upon it lengthwise*, like the scale of a burette. We may distinguish these two kinds of pipette, by the names of *BULB Pipette* and *SCALE Pipette*. These pipettes serve for measuring various quantities of a liquid, commensurate with the capacity of the bulbs, or the degrees marked on the scales. The chief use of pipettes is to measure with precision that quantity of a solution which is to be subjected to volumetric analysis, or that dose of a graduated test liquor which is required for a specific operation. The proper construction and management of a pipette require a few observations. The lower opening, from which the liquor is to flow, ought not to be more than $\frac{1}{32}$ inch (=1 millimetre) in diameter. The upper end, which is to be closed by a wet finger when in use, ought to be made narrow by melting and thickening the glass, and then be cut square across, and ground or fused flat, so that the finger can press upon it firmly. This contracted form is shown by the upper ends of Figs. 2768 *c* and 2769 *a*.

2761. *To Fill the Pipette.*—Wet the ball of the forefinger of the right hand, hold the pipette near the top by the thumb and middle finger of that hand, put the lower end of the pipette into the liquor that is to be used, apply the mouth to the upper end, and gently suck up the liquor into the pipette, carefully watching its rise, until you perceive it to be as high as you wish it; immediately upon which you remove your mouth, and instantly fix your forefinger firmly on the top of the pipette. During this process, you must take care that the point of the pipette remains always below the surface of the liquor, otherwise air enters the pipette, and may force the liquor up into your mouth,—an accident which, as these liquors are always unpleasant and sometimes poisonous, is to be avoided. An effectual preventive is, to begin the operation by dipping the point of the pipette sufficiently deep into the liquor, and holding it firmly there by the left hand, during the inspiration. In cases where poisonous solutions have to be transferred, the apparatus represented by Fig. 2770 may be used. The graduated tube *a* is then held by the left hand, the caoutchouc tube *b* is held by the right hand, and the point is put into your mouth; the eye is then placed opposite the point *a*, to which the liquor is to be made to rise, and when it is sucked up to that point the flexible tube *b* is pinched to stop the farther rise of the liquor.

2762. *To Regulate the Pipette.*—The pipette being filled and held over the liquor from which it has been supplied, the pressure of the finger on the top is to be relaxed, and the liquor allowed to flow out slowly in drops, until the black curve at the surface of the water in the pipette exactly touches the line of 0° , or other desired degree. The pipette is then to be removed over the mixing jar, previously placed close at hand, and the contents to be delivered into it.

2763. *To Deliver the Contents of a Pipette.*—There are several methods of delivering the contents of a pipette. 1. The contents are allowed to run freely into the mixing jar without permitting the point of the pipette to touch the glass, and without your blowing out the last drop from the pipette. 2. After delivering the bulk of the liquor, the point of the pipette is made to touch the inside of the mixing jar, in order that capillary attraction may carry away the drop that adheres to the point of the pipette. 3. While holding the pipette as last described, you apply your mouth to the top of it and blow out the drop adhering at the point. This last is the safest method; but as instruments of this kind are not adjusted on the same plan by all manufacturers, it is necessary, for those who use the pipette, to try which of these methods answers best with a given pipette. 4. Another point to be noticed is, that different liquors have different degrees of adherence to the pipette, and do not run out of it in the same time. Every operator should, for these reasons, make himself acquainted with the actual *delivering power* of his pipettes. Among other proofs an important one is, to try whether his pipettes deliver quantities which agree with the graduations on his burette. For example, he may adjust the liquor in his burette to 50° , and then, with a pipette marking 10° , he may deliver successive doses of 10° from the pipette into the burette, and observe whether the liquor rises regularly in the burette, as it ought to do, to 60° , 70° , 80° , 90° , 100° .

2764. The first class of pipettes—namely, the pipettes to deliver *one quantity*—are made to deliver the true quantity, independently of what adheres to the inner surface of the pipette; but in general, the pipettes with long scales are so graduated as to show what they *contain*, and therefore they will *deliver* something less than the true quantity. When the pipettes are used for small quantities, and the lower opening is made so small as to cause slow delivery, this difference is not of much consequence. The operator, moreover, has it in his power, by trying his pipette against his burette, to determine what is the amount of loss by adhesion.

2765. *Form of Pipettes.*—When pipettes are to be used to take normal test liquors from stock bottles, it is convenient to have them of a form that will enter the neck of the bottle and go nearly to the bottom. Such forms are represented by the Fig. 2768, *d* and *e*. But when the pipettes are for large quantities, this would sometimes cause them to be inconveniently long. In such a case, and also whenever the liquor to be measured is contained in an open vessel, pipettes of the form of Figs. 2768, *a*, *b*, *c*, may be used. When test liquors have to be poured from a narrow-necked bottle to be taken up by a broad pipette, the most convenient form of vessel to be used is a beaked tumbler, Fig. 2765. But it is very desirable to avoid this transferral of test liquors by having them in bottles into which the pipette can be dipped.

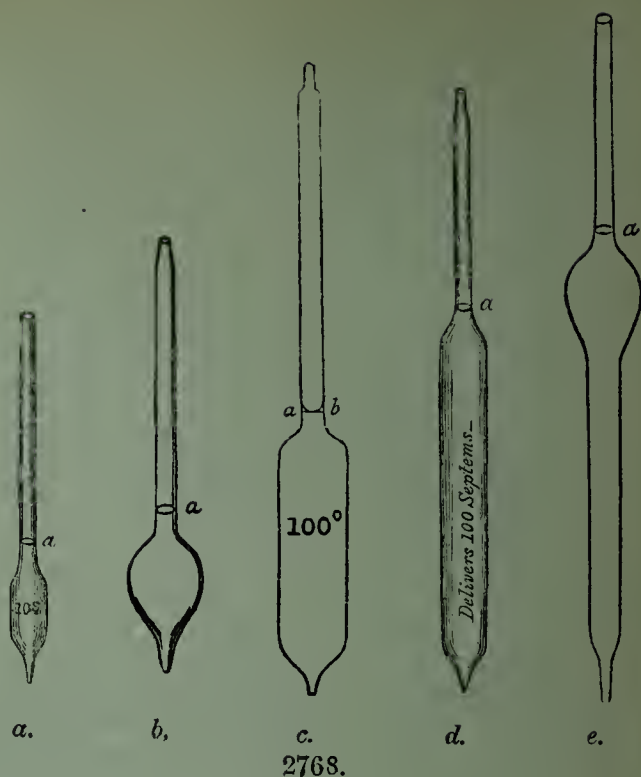


2765.

2766. *Rising and Descending Scales of Pipettes.*—The graduation of measuring pipettes is usually commenced at the bottom. Thus, Fig. 2769, *b*, represents a pipette of Gay-Lussac's, adapted to deliver 1, 2, or 5 Centimetre Cubes. In imitation of this plan, Fig. 2769, *c* and *d*, are also graduated with 0° at the bottom. I do not approve of this method, because it is difficult to make such an instrument so accurately that the lowest and most important degree shall be correct. I prefer to make and use an instrument graduated like Fig. 2769, *a*, in which the degree 0 is at the top of the scale. With this pipette the liquor is sucked up to 0° , and then the required quantity is slowly dropped from it into the proper vessel. In order that the analyst may be able, during an inspiration, to watch the ascent of the liquor to the proper height, the degree of 0° should never be at less than 4 inches from the upper end of the tube. When a pipette is graduated close to the top like Fig. 2769, *c*, it should be used with a caoutchouc sucking tube, like that shown in Fig. 2770.

In reading the scales of pipettes, and indeed of all graduated instruments, you are to take, as the true indication, *the line that touches the lower part of the black curve that is formed by the surface of the liquid, as represented by the line $a b$ in Figs. 2768 c and 2780.* The way to make the black curve most distinct has been explained at No. 2743.

2767. *Importance of the Pipette.*—I have given an extended description of the Pipette, because it is an instrument of great importance, holding the same rank in Volumetric Analysis that the BALANCE holds in Gravimetrical Analysis. It is that which sets out the quantity of material which is to be submitted to analysis, and it is therefore important that the instrument should be as correct as possible, and that the operator should understand the peculiarities upon which its accurate use depends. The more perfect the action of the Pipette, the smaller is the quantity of fluid that any analysis may be successfully made with; and, as a consequence, the smaller will be the quantity of test solutions required for the purpose, and the smaller and more delicately-graduated may be the Burette and all the other Volumetric Apparatus.



2768. BULB PIPETTES, namely, Pipettes which have ONE MARK on the neck, Fig. 2768, a, b, c, d, e , and which serve to DELIVER ONE QUANTITY.

Graduated for Centimetre Cubes.

1.	1	cc.	6d.
2.	2	cc.	6d.
3.	5	cc.	8d.
4.	10	cc.	10d.
5.	15	cc.	1s.
6.	20	cc.	1s.
7.	25	cc.	1s. 3d.
8.	50	cc.	1s. 6d.
9.	75	cc.	1s. 9d.
10.	100	cc.	1s. 9d.
11.	150	cc.	2s.
12.	200	cc.	2s. 6d.
13.	250	cc.	3s.

Graduated for Septems.

14.	1	Septem	6d.
15.	2	Septems	6d.
16.	5	Septems	6d.
17.	10	Septems	9d.
18.	15	Septems	10d.
19.	20	Septems	10d.
20.	25	Septems	1s.
21.	50	Septems	1s. 3d.
22.	100	Septems	1s. 6d.
23.	200	Septems	2s.

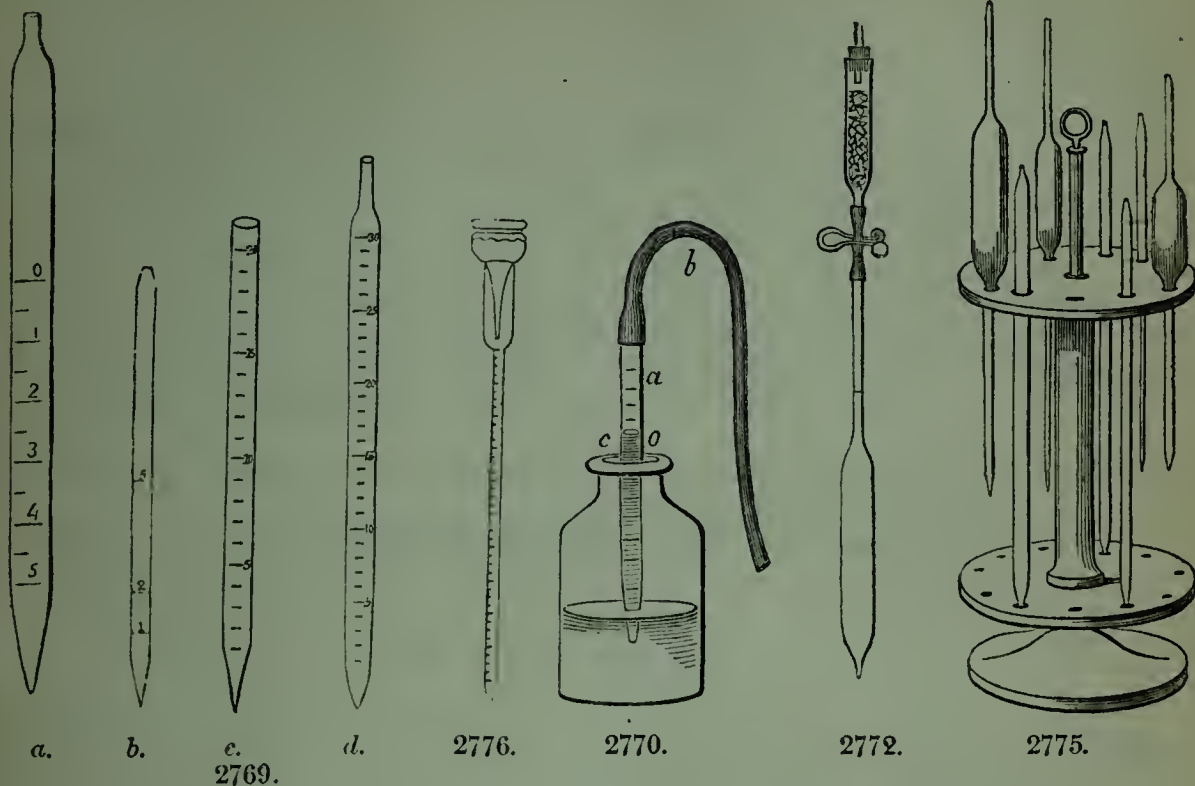
Graduated for Decems.

24.	1	Decem	6d.
25.	2	Decems	6d.
26.	5	Decems	6d.
27.	10	Decems	10d.
28.	15	Decems	10d.
29.	20	Decems	10d.
30.	25	Decems	1s.
31.	50	Decems	1s. 6d.
32.	100	Decems	1s. 9d.

Graduated for Special Quantities.

33.	1	Fluid Ounce	1s.
34.	2	Fluid Ounces	1s. 6d.
35.	1	Ounce Troy	1s.
36.	1	Cubic Inch	1s.
37.	2	Cubic Inches	1s. 6d.
38.	100	Grains	10d.
39.	500	Grains	1s. 6d.
40.	1000	Grains	1s. 9d.
41.	1	Fluid Drachm	1s.
42.	8	Fluid Drachms	1s. 3d.
43.	100	Test Measures for Clark's Soap Test	1s. 9d.
44.	100	Minims	1s. 9d.

2769. SCALE PIPETTES, namely Pipettes that are graduated from end to end, to afford the means of measuring ANY GIVEN QUANTITY within the Capacity of the Instrument, Fig. 2769, *a, b, c, d*.



Graduated into Centimetre Cubes.

1.	1	CC. in	$\frac{1}{10}$	1s.
2.	1	"	$\frac{1}{100}$	1s. 6d.
3.	2	"	$\frac{1}{50}$	1s.
4.	2	"	$\frac{1}{100}$	1s. 6d.
5.	5	"	$\frac{1}{20}$	1s. 6d.
6.	5	"	$\frac{1}{100}$	1s. 9d.
7.	10	"	$\frac{1}{10}$	1s. 6d.
8.	10	"	$\frac{1}{50}$	2s.
9.	10	"	$\frac{1}{100}$	2s. 3d.
10.	15	"	$\frac{1}{100}$	3s.
11.	20	"	$\frac{1}{50}$	2s. 6d.
12.	20	"	$\frac{1}{100}$	3s.
13.	25	"	$\frac{1}{20}$	2s. 6d.
14.	25	"	$\frac{1}{50}$	3s.
15.	25	"	$\frac{1}{100}$	3s. 3d.
16.	30	"	$\frac{1}{50}$	3s. 6d.
17.	50	"	$\frac{1}{10}$	3s. 3d.
18.	50	"	$\frac{1}{20}$	4s.
19.	50	"	$\frac{1}{50}$	4s. 6d.
20.	50	"	$\frac{1}{100}$	5s. 6d.
21.	100	"	$\frac{1}{10}$	5s.
22.	100	"	$\frac{1}{20}$	5s. 6d.
23.	150	"	$\frac{1}{10}$	6s.
24.	200	"	$\frac{1}{10}$	7s.

Graduated into Septems.

25.	1	Septem in	$\frac{1}{10}$	9d.
26.	1	"	$\frac{1}{50}$	1s.
27.	2	"	$\frac{1}{100}$	1s.
28.	5	"	$\frac{1}{100}$	1s. 3d.
29.	10	"	$\frac{1}{10}$	1s.
30.	10	"	$\frac{1}{50}$	1s. 3d.
31.	15	"	$\frac{1}{10}$	1s. 3d.
32.	20	"	$\frac{1}{10}$	1s. 6d.
33.	20	"	$\frac{1}{50}$	1s. 9d.
34.	20	"	$\frac{1}{100}$	2s.
35.	25	"	$\frac{1}{10}$	1s. 6d.
36.	25	"	$\frac{1}{50}$	2s.
37.	30	Septems in	$\frac{1}{10}$	1s. 9d.
38.	30	"	$\frac{1}{20}$	1s. 9d.
39.	50	"	$\frac{1}{10}$	2s.
40.	50	"	$\frac{1}{20}$	2s. 6d.
41.	80	"	$\frac{1}{10}$	3s.
42.	100	"	$\frac{1}{10}$	3s. 6d.
43.	200	"	$\frac{1}{10}$	5s.

SCALE PIPETTES, (continued from page 299.)

<i>Graduated into Décems.</i>				<i>Special Graduations.</i>			
44.	5	Decems in $\frac{1}{10}$	1s. 6d.	57.	50	Grains of Water in 50°	1s. 6d.
45.	10	„ $\frac{1}{2}$	1s. 6d.	58.	1	Cubic inch in $\frac{1}{10}$ = 10°	2s. 6d.
46.	10	„ $\frac{1}{10}$	2s.	59.	5	Cubic inches in $\frac{1}{5}$ = 25°	3s.
47.	25	„ $\frac{1}{1}$	1s. 6d.	60.	20	Clark's Soap Test Measures in $\frac{1}{8}$ = 100°	2s. 6d.
48.	25	„ $\frac{1}{2}$	2s.	61.	100	Minims in $\frac{1}{1}$	2s. 6d.
49.	25	„ $\frac{1}{5}$	2s. 6d.	62.	150	„ $\frac{1}{1}$	3s.
50.	25	„ $\frac{1}{10}$	3s.	63.	200	„ $\frac{1}{1}$	3s. 6d.
51.	50	„ $\frac{1}{1}$	3s.	64.	1	Fluid Ounce in 8 Drachms	2s. 6d.
52.	50	„ $\frac{1}{2}$	3s. 3d.				
53.	50	„ $\frac{1}{5}$	3s. 6d.				
54.	50	„ $\frac{1}{10}$	4s. 6d.				
55.	100	„ $\frac{1}{1}$	4s. 6d.				
56.	100	„ $\frac{1}{2}$	5s.				

2770. Caoutchouc Sucking Tube attached to any Pipette, Fig. 2770, (for its use see No. 2761), increases the price 6d.

2771. Measuring Pipettes, with Glass Stopcock, graduated into Cubic Centimeters and subdivisions.

1.	10	CC. in $\frac{1}{5}$	3s. 6d.	6.	50	CC. in $\frac{1}{2}$	6s. 6d.	11.	75	CC. in $\frac{1}{5}$	8s.
2.	10	„ $\frac{1}{10}$	4s.	7.	50	„ $\frac{1}{5}$	7s.	12.	100	„ $\frac{1}{1}$	8s.
3.	25	„ $\frac{1}{2}$	5s.	8.	50	„ $\frac{1}{10}$	7s. 6d.	13.	100	„ $\frac{1}{2}$	8s. 6d.
4.	25	„ $\frac{1}{5}$	5s. 6d.	9.	75	„ $\frac{1}{1}$	7s.	14.	200	„ $\frac{1}{1}$	9s.
5.	25	„ $\frac{1}{10}$	6s.	10.	75	„ $\frac{1}{2}$	7s. 6d.				

2772. Mohr's Safety Pipette for measuring Chlorine Water, Prussic Acid, &c., contents 10 Centimetre Cubes, with safety tube, caoutchouc tube and pinchcock. Fig. 2772, page 299, 2s. 6d.

2773. The same apparatus, contents 20 Septems, 2s. 6d.

2774. The same apparatus, contents 10 Décems, 2s. 6d.

The Safety Tube is filled with a mixture of quicklime and sulphate of sodium. See No. 2823.

2775. REVOLVING SUPPORT FOR 8 PIPETTES, Fig. 2775, page 299, polished black wood, 8s. 6d.

2776. Funnel Pipettes, tied over with caoutchouc, for delivering test liquors in small quantities, or in drops, Fig. 2776, page 299.

a. 20 Centimetre Cubes in $\frac{1}{2}$ CC., 2s. 6d.

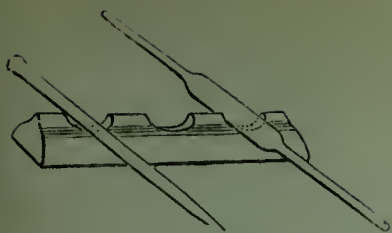
b. 50 Centimetre Cubes in $\frac{1}{2}$ CC., 4s.

RESTS FOR PIPETTES.

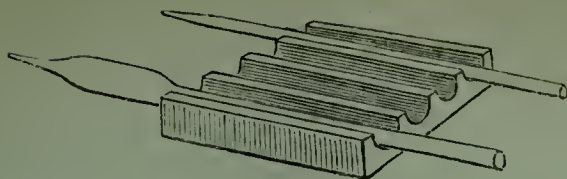
2777. Porcelain Notched Rests for Stirrers and Pipettes, to keep their wet end from touching the table, Fig. 2777, page 301.

a. 3 inch, 6d. | b. 4 inches, 9d. | c. 6 inch, 1s.

2778. PORCELAIN FLUTED RESTS, Fig. 2778, to keep wet Pipettes or Stirrers from touching the table, size of slab, 3 inches square with 4 flutes. 1s. 9d.



2777.



2778.



2779 a.

It is convenient to have a pair of these rests, one for pipettes that are wet with Basic liquors, and another for such as are wet with Acids.

2779 a. Glass Stirrers with broad knob, for preparing solutions of hard substances such as American potash, Fig. 2779a, 9 or 10 inches long, stout, 3d.

2779 b. Glass Solution Jar for use with knobbed stirrers, Fig. 2779 a, capacity one to two pints, very stout in glass, 1s.

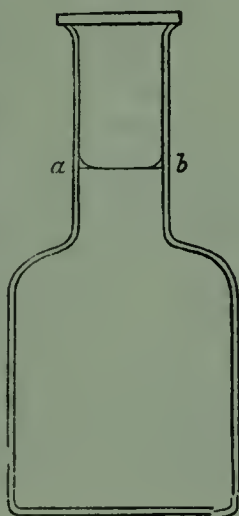
2779. Glass Stirrers, round at one end, pointed at the other, 3 inch, per dozen, 2d. 6 inch, per dozen, 4d.; 9 inch, thick, per dozen, 1s.

MEASURING FLASKS.

2780. MEASURING FLASKS are Flasks that have ONE MARK on the neck, when filled to which they contain the quantity specified.

The standard flasks, which contain the normal volumes of test solutions are these three :—1. The LITRE, to be used with burettes that are graduated into Centimetre Cubes. 2. The DECIGALLON, to be used with burettes that are graduated into Septems; and 3. A flask to contain TEN THOUSAND GRAINS OF WATER, (to which liquid mass no specific name has been yet applied) which is used with burettes graduated into Decems. With these standard flasks, it is necessary to have a few that will measure decimal portions of the three standards, especially $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{10}$.

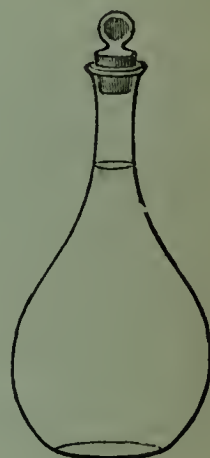
Figs. 2780 and 2781 represent measuring flasks without stoppers, and Fig. 2785, a measuring flask with a stopper.



2780.



2781.



2785.

2783. MEASURING FLASKS, WITHOUT STOPPERS, and with one mark on the neck.

1.	5 Cent Cubes	6d.	15.	100 Septems	1s.
2.	10 Cent Cubes	6d.	16.	200 Septems	1s. 3d.
3.	20 Cent Cubes	9d.	17.	250 Septems	1s. 3d.
4.	25 Cent Cubes	9d.	18.	300 Septems	1s. 6d.
5.	50 Cent Cubes	1s.	19.	500 Septems	1s. 9d.
6.	100 Cent Cubes	1s. 2d.	20.	1 Decigallon	2s.
7.	150 Cent Cubes	1s. 4d.	21.	25 Decems	9d.
8.	200 Cent Cubes	1s. 6d.	22.	50 Decems	1s.
9.	250 Cent Cubes	1s. 6d.	23.	100 Decems	1s. 6d.
10.	300 Cent Cubes	1s. 9d.	24.	500 Decems	2s.
11.	500 Cent Cubes	2s.	25.	1000 Decems	2s. 6d.
12.	1 Litre	3s.	26.	1 Cubic inch	9d.
13.	2 Litres	3s. 6d.	27.	$\frac{1}{4}$ Imperial pint	1s. 6d.
14.	50 Septems	9d.	28.	1 Imperial pint	2s. 3d.

2785. MEASURING FLASKS with STOPPERS, and a ring round the neck, Fig. 2785.

1	100 Cent. Cubes	2s.	4.	$\frac{1}{2}$ Litre	3s.
2.	125 Cent. Cubes	2s. 3d.	5.	1 Litre	3s. 6d.
3.	250 Cent. Cubes	2s. 6d.	6.	2 Litre	4s. 6d.

2786. MEASURING FLASKS, with STOPPERS and a mark on the neck. ENGLISH MEASURES
Fig. 2785.

1.	1 Decigallon	2s. 6d.	5.	1000 Grains	1s. 6d.
2.	1000 Decems	3s.	6.	100 Septems	1s. 6d.
3.	1 Imperial Pint	2s. 6d.	7.	250 Septems	2s.
4.	1 Cubic Inch	1s. 6d.	8.	500 Septems	3s.

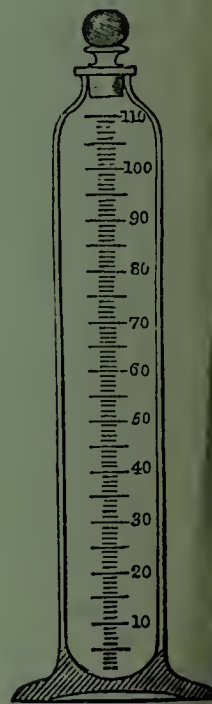
TEST MIXERS.

2790. TEST MIXERS are tall cylindrical bottles, with broad feet and stoppers, as represented by Fig. 2790. They are used to prepare test acids, test alkalies, and similar solutions, by the dilution of strong solutions to others of a fixed degree. Thus, supposing it to have been found by a volumetric experiment, that a certain acid possesses as much neutralizing power in 70 measures as it ought to possess in 100 measures, then, to bring that acid into its normal condition, 70 measures of it are to be put into a test mixer, and diluted with water till the volume becomes 100 measures at 62° F. For this purpose, the test mixer is graduated into 100, or rather more than 100, equal parts, and the scale upon it is written from below upwards, as represented in Fig. 2790.

From this description it will be seen that the Measuring Flask differs from the Test Mixer in this particular, that, in the former, a weighed equivalent of a solid chemical is dissolved in water and diluted till it forms a standard measure, such as a Litre, a Decigallon, or 1000 Decems, whereas in the latter, an equivalent of a dissolved chemical is diluted from a specific measure which is determined by a volumetric analysis to the standard measure of a Litre, a Decigallon, or 1000 Decems. Vessels of both sorts are required for the preparation of the test solutions which are employed in the processes of volumetric analysis.

2791. STOPPERED TEST MIXERS, form of Fig. 2790, differing in price according to their capacity, but all graduated to 100 equal parts, as follows:—

1.	Contents	1	Decigallon	=	100	Spaces of 10	Septems, 6s.
2.	"	2	"	=	100	" 20	" 9s.
3.	"	5	"	=	100	" 50	" 12s. 6d.
4	"	500	Decems	=	100	" 5	Decems 5s.
5.	"	1000	"	=	100	" 10	" 7s. 6d.
6	"	4000	"	=	100	" 40	" 14s.
7.	"	$\frac{1}{2}$	Litre	=	100	" 5	C. Cubes 6s.
8.	"	1	"	=	100	" 10	" 9s.
9.	"	2	"	=	100	" 20	" 12s. 6d.
10.	"	$2\frac{1}{2}$	"	=	100	" 25	" 14s.



2790.

The Test Mixers Nos. 3, 6, 10, are the largest sizes which can be handled with convenience and safety.

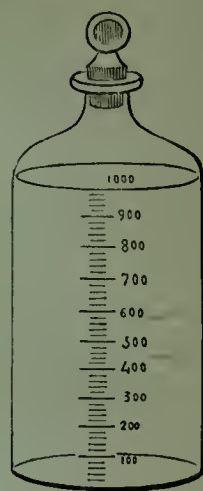
2792. GRADUATED GLASS CYLINDERS, or Jars with Spouts, or with Flange and Feet, but without stoppers, graduated with scale of 100 divisions, having 0° at the bottom, Fig. 2792.

These serve as TEST MIXERS, but since the liquors can only be mixed in them by stirring with a glass rod, they are not so convenient or effective as the Stoppered Test Mixers.

1.	Contents	1 Decigallon,	5s.
2.	„	2 „	8s.
3.	„	5 „	12s.
4.	Contents	1000 Decems,	6s.
5.	„	$\frac{1}{2}$ Litre	5s.
6.	„	1 „	8s.



2792.



2793.

2793. GRADUATED STOPPERED BOTTLES, scale of 50 divisions, marked either as 100° or 1000°, the zero at the bottom. Fig. 2793. Useful as test mixers, or to store test solutions.

1.	Contents	1 Decigallon,	7s.	3.	Contents	$\frac{1}{2}$ Litre,	7s.
2.	„	1000 Decems	8s.	4.	„	1 „	9s.

2794. Cylindrical Jars, on foot, with spout, in the form of Fig. 2792, or with flange, graduated into Centimetre Cubes.

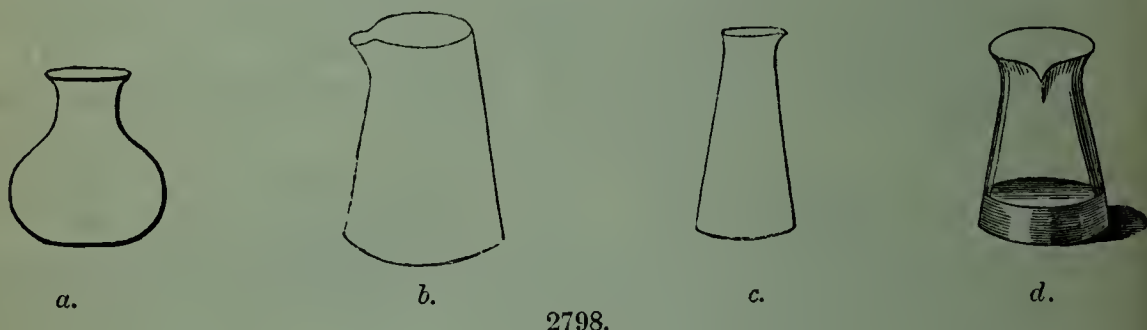
1.	5 cc.	1s	7.	150 cc.	3s.	12.	500 cc.	5s.
2.	10 cc.	1s.	8.	200 cc.	3s. 3d.	13.	600 cc.	5s. 6d.
3.	25 cc.	1s. 6d.	9.	250 cc.	3s. 6d.	14.	700 cc.	6s.
4.	50 cc.	2s.	10.	300 cc.	4s.	15.	800 cc.	7s.
5.	75 cc.	2s. 3d.	11.	400 cc.	4s. 6d.	16.	1000 cc.	8s.
6.	100 cc.	2s. 6d.						

2795. Cylindrical Jars on foot with Flange and Stoppers, graduated into Centimetre Cubes, for mixing and diluting various quantities of test solutions :—

1.	25 Cent. Cubes,	2s. 6d.	8.	300 Cent. Cubes,	6s.
2.	50 „	3s.	9.	400 „	6s. 6d.
3.	75 „	3s. 6d.	10.	500 „	7s.
4.	100 „	4s.	11.	600 „	8s.
5.	150 „	4s. 6d.	12.	700 „	8s. 6d.
6.	200 „	5s.	13.	800 „	9s.
7.	250 „	5s. 6d.	14.	1000 „	10s. 6d.

MIXING JARS.

2798. MIXING JARS are vessels in which a liquid that is to be analysed volumetrically mixed, stirred, shaken, or boiled, with the graduated test solution that is to effect the analysis. Fig. 2798, *a, b, c, d*, represents some of the most suitable forms for such vessels. They should be made of fine, hard, colourless German or Bohemian glass, and be thin, flat, smooth, and clear at the bottom, to permit changes of colour to be easily seen, either when you look across the vessel against the light, or down into it when it is placed upon a white ground, such as the porcelain slab No. 2800. Vessels of the forms here represented may be shaken by a careful circular motion, so as thoroughly to mix the liquors they contain, without spilling any; and when made of the proper kind of glass they may all be safely heated till their liquors boil, over a wire grating or a rose-gas burner.



2798.

2798. VARIETIES OF MIXING JARS :—

Fig. *a*. Wide-mouthed, flat-bottomed flask, of fine clear glass.

1.	3 to 4 ounce	4d.
2.	$\frac{1}{4}$ pint	5d.
3.	$\frac{1}{2}$ pint	7d.
4.	1 pint	9d.

Fig. *b*. Conical Jar, with spout and flat bottom, fine German glass.

5.	$\frac{1}{4}$ pint	6d.
6.	$\frac{1}{2}$ pint	8d.
7.	1 pint	1s.

Fig. *c*. Tall and narrow Conical Jar, with flat-bottom, fine clear Bohemian glass.

8.	$\frac{1}{4}$ pint	8d.
9.	$\frac{1}{2}$ pint	10d.
10.	1 pint	15d.

Fig. *d*. Conical Jar, with sides curve inwards, flat bottom, with spout.

11.	$\frac{1}{4}$ pint	4d.
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Fig. *d*. Conical Jar with sides curve inward, and expanding mouth without spout.

12.	$\frac{1}{4}$ pint	6d.
13.	$\frac{1}{2}$ pint	8d.

For many operations in Volumetric Analysis, when the quantity of liquid operated upon is 10 septems, 50 Cent. Cubes, or even 100 Decems, a Mixing Jar of the $\frac{1}{4}$ pint size is sufficiently large for convenient use; but in some cases it is necessary to take half pint, or even pint jars to contain the mixed liquors.

2798*e*. GRADUATED MIXING JARS, with 1, 2, or 3 marks, namely, 100, 250, and 500 Septems, Decems, or Centimetre Cubes, extra price for 1 mark, 6d.; for 2 marks, 9d.; for 3 marks, 1s.

It is very convenient, when testing a series of solutions, especially when colour tests are to be used, to dilute the solutions with water to a given bulk. Thus, in testing the acidity of wine and other organic coloured fluids, a considerable dilution must be effected, in order that the colour of the liquid to be tested may not interfere with the observations to be made on the action of the colour test that is used to mark the point of transition from acidity to alkalinity; and as it is best to act upon uniform masses of liquor, it is handy to have the measure marked on the mixing jar.

2799. SHAKING BOTTLE, stoppered, Fig. 2799, for mixing liquors that require considerable agitation. Such as soap test with hard water, chloride of silver, &c., six ounce size, flat-headed stopper, 8d.
2800. WHITE GLAZED PORCELAIN SLAB, to place below a Mixing Jar during a Volumetric Analysis, for the purpose of rendering changes of colour immediately evident, size 6 inches square, $\frac{1}{2}$ inch thick, glazed all over. See *d*, Fig. 2701, and *d*, Fig. 2711, 1s.



2799.

INDICATORS.

2805. When a liquid is submitted to volumetric analysis, the graduated test solution is added to it, until some *visible effect* is produced, which *indicates* that enough of the test solution has been used. Whatever serves to produce this visible effect, is called the *Indicator*. The success of an analysis often depends upon the operator's power of appreciating the exact point when the Indicator exhibits its decisive action. I may notice some of the chief Indicators, in order to point out their different modes of action.

2806. *Change of Colour in the Mixture*.—When a solution of permanganate of potash, which possesses a dark red colour, is added to a ferrous salt, it instantly loses its colour. When the ferrous salt is converted by the action of the test into ferric salt, that is to say, when Fe^2 has become Fe^3 the first superfluous drop of the permanganate solution gives a pink colour to the mixture. This pink colour is the Indication of the completion of the testing.

2807. *Colour Tests*.—When acids are mixed with alkalies, no *visible effect* is produced to show when neutralization is completed, or when either acid or alkali is present in excess. The indicators that are used to remedy this defect are either litmus tincture, which becomes *red* in the presence of free acid, and *blue* in the presence of free alkali, or tincture of hematine, which becomes *yellow* in the presence of free acid, and *pink, crimson, or violet* in the presence of free ammonia.

2808. *Starch*.—When Iodine is set free in any mixture, even in an extremely small quantity, it is instantly detected by starch paste, which becomes blue. The starch paste is commonly put into the mixture.

2809. *Yellow Chromate of Potash*.—When a solution of yellow chromate of potash is tested with a solution of nitrate of silver in a neutral or slightly alkaline solution, a *dark red precipitate* is produced. But while any metallic chloride is present in the solution, no red precipitate is formed by the chromate until the whole of the chlorine has been precipitated in the condition of chloride of silver. The yellow chromate of potash serves therefore to indicate the completion of the volumetric testing of a chloride by a solution of silver. The indicator is generally mixed with the subject to be tested, but is sometimes tried apart. See No. 2951 *b*, and No. 2941 *a*.

2810. *Ferridcyanide of Potassium*.—A test solution of bichromate of potash, added to a solution of a ferrous salt converts it into a ferric salt. But the mixture gives no visible indication of the completion of the operation. The Indicator to be used in this case, is a solution of the ferridcyanide of potassium, which gives a blue precipitate with a ferrous salt, but none with a ferric salt. The indicator cannot be put into the mixture, because it acts upon the substance submitted to analysis and not upon the testing solution, so that its action would *precede* the action of the test, instead of *indicating its conclusion*. It is necessary, therefore, from time to time, to take some of the solution out of the Mixing Jar, and try by the action of the indicator in a separate vessel when the process is completed. This is a disadvantage, because every such trial removes a certain quantity of the liquor that is subjected to analysis from the action of the test, and impairs the accuracy of the analysis. To restrict the loss of substance as much as possible, the trials are made upon very small quantities of liquor by the process described at No. 2816. This method can be used with all indicators that give Coloured Precipitates.

QUICK FILTERS.

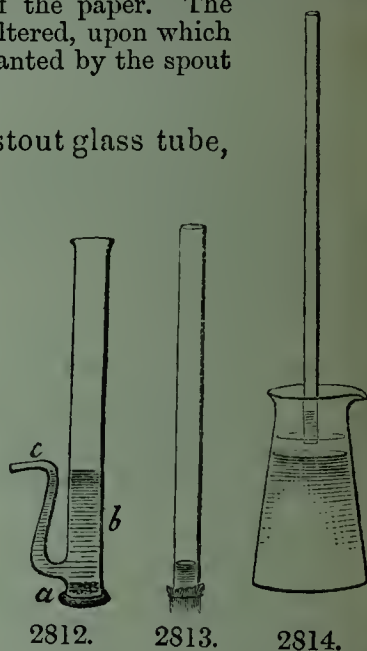
2811. When solutions of Barytic Salts are tested with solutions of sulphates, a precipitate of sulphate of barytes is produced, which, although insoluble, remains so long in suspension, that it is difficult to see when the operation is terminated. The indication is, that a farther addition of the test solution should give no farther precipitate. But when the mixture is turbid, it cannot be seen upon adding more test liquor, whether such additional precipitation occurs or not. It is consequently necessary to separate the sulphate of barytes from a portion of the mixture by filtration, in order to have a clear liquor for farther trial. Successive filtrations for successive trials being tedious by ordinary methods of filtering, the following attempts have been made to effect filtrations rapidly:—

2812. BEALE'S QUICK FILTER, for the rapid filtration of Liquors that contain small quantities of sulphate of barytes, &c., in suspension, form of Fig. 2812, 1s.

The bottom of the wide tube is tied over with a bit of filtering paper, covered by a slip of washed muslin *a*, and is dipped into distilled water to close the pores of the paper. The apparatus is then pressed downwards into the liquor that is to be filtered, upon which a portion of the solution rises clear into the tube *b*, and can be decanted by the spout *c*, into the test glass, No. 2817.

2813. GRIFFIN'S QUICK FILTER, Fig. 2813, consisting of a stout glass tube, 6 inches long, and about $\frac{1}{8}$ inch bore, 3d.

The projecting spout of Beale's filter *c*, Fig. 2812, frequently prevents the dipping of the instrument into the mixing jar; for example, when the precipitated sulphate of barytes has been boiled in a flask like *a*, Fig. 2798, I find it more convenient to make the filter in the form of Fig. 2813, which consists of a plain tube without contraction or expansion, about $\frac{1}{8}$ inch in the bore, $\frac{1}{2}$ inch thick in the glass, and 6 inches long. The filtering paper, without muslin, is tied over the end with a thread. The tube is dipped into the mixture that is to be filtered, until two or three drops, or more when necessary, have risen within it. The top is then to be firmly closed by the finger; the tube to be lifted out of the mixture, and the liquor to be allowed to drain from the outside of the tube by gently touching the inside of the jar with the filter, after which the drops within the tube may be suddenly decanted from the upper or open end of the tube into the test glass, No. 2817, for trial by the indicator, which being in this case the graduated test liquor that is used for the analysis, the mixture can, after the trial, be returned from the test-glass to the mixing jar, and thus avoid loss.



2812.

2813.

2814.

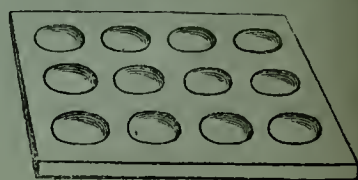
2814. DECANTING TUBE, Fig. 2814, 6 inches long, $\frac{1}{8}$ inch bore, smooth at both ends, 3 for 6d.

It often happens that when a turbid mixture has been well shaken, especially after boiling, the precipitate it contains slowly settles down and leaves a very shallow stratum of clear liquor upon its surface. By using a very narrow glass tube, cut off smooth and square at the ends, it is possible to remove from the surface of such a mixture a sufficient quantity of clear liquor for testing, without waiting till the mass of precipitate subsides. The method is exhibited by Fig. 2814. The tube is made barely to touch the surface of the liquor; it is not dipped into it; no suction is applied, because the effect of capillary attraction is alone sufficient to raise the required quantity of clear liquor. When the mixture allows this abstraction of clear liquor to be effected, it is, of course, much preferable to filtration.

2815. PORCELAIN SLAB, for trying the action of COLOUR TESTS in volumetric analysis, Fig. 2815, consisting of a thin slab of white glazed porcelain, containing 12 small cavities or cells about $\frac{1}{8}$ inch deep, for holding drops of liquor to be tested. Two sizes, namely:—

a. Berlin porcelain, $4\frac{1}{2}$ inches long, $3\frac{1}{2}$ inches broad, with 12 shallow cells of $\frac{3}{4}$ inch diameter, 1s. 6d.

b. Thuringian porcelain, 4 inches long, 3 inches broad, with 12 deeper cells of $\frac{5}{8}$ inch diameter, 1s.



2815.

2816. For the reasons stated in No. 2810, experiments with indicators have to be made on the smallest possible quantities of liquor. The solution of the indicator should in most cases be very dilute. At the beginning of a process, the indicator should be put into each of the cavities in the slab. It is best to lift it with a plain glass tube, 6 inches long, and $\frac{1}{8}$ to $\frac{1}{4}$ inch in the bore; namely, the decanting tube, No. 2814. The tube is made barely to touch the surface of the liquor, upon which a sufficiency of liquor rises into it by capillary attraction, and is transferred to the slab, the dot upon which ought not to exceed $\frac{1}{8}$ inch in diameter. Subsequently, during the process of a volumetric analysis, the mixture to be tried is lifted with a decanting tube, No. 2814, in the same manner, and the minute drop is blown from the tube into the drop of indicator previously deposited in one of the cavities on the slab, or is made to run down by touching the edge of the cavity.

2817. Test Glass for examining small quantities of liquors, form of Fig. 2817, about 1 inch high, and 1 inch wide. *Per Dozen*, 1s. 6d.

When the indicator produces a white precipitate, such as sulphate of barium, the trial cannot be made on the porcelain slab. The best thing to use in that case is a small test glass, similar to Fig. 2817, but about one half larger. As only small quantities of liquor are to be operated upon, a large test glass ought never to be used, because it spreads the drops of liquor over too large a surface of glass.

2818. PIPETTE BOTTLE FOR TINCTURE OF LITMUS, HEMATINE, OR OTHER COLOUR TEST, with Cap, Fig. 2818, but without inscription, 5-ounce size, 1s.



2817.

2818.

The pipette should be cylindrical, not made with a narrow point. It should be about $\frac{1}{2}$ inch in the bore, so that about half a centimetre cube or one septem of the colour-test can be readily lifted for use in each operation. It is proper to have uniformity in the quantity of colour test placed under observation in each experiment, to help in the precise detection of change of colour.

2819. LITMUS TEST PAPERS are useful in all delicate processes. See No. 2423.

PRESERVATION OF TEST LIQUORS AND THE MANNER OF FILLING BURETTES.

2823. This subject has already been partially discussed in preceding paragraphs, especially in Nos. 2690, 2692, 2693, 2704, 2710, and 2729. The Test solutions should be kept in stoppered glass bottles, preferably in bottles of hard glass, because some of the Test Liquors act readily upon flint glass. The bottles should be kept in a cool place, and if possible in a dark place, as some liquors are acted on by light. In certain cases it is better to replace the glass stopper by a cork, carrying a chloride of calcium tube, filled with a mixture for absorbing carbonic acid, which arrangement permits the access of air, but prevents the formation of carbonates. Such safety tubes are sometimes applied to burettes that are filled with caustic alkalies. See examples in Figs. 2698, 2708, 2709, 2824. The mixture for filling these tubes is prepared as follows:—Pound in a mortar equal volumes of crystallized sulphate of sodium and fresh burnt lime. Mix the powders, and let them lie on one another. Dry the mixture over a fire or gas-light, in such a manner as to cause it to form small lumps. Fill the tube with these lumps, avoiding dust, and putting a loose plug of cotton at each end of the tube to prevent the mixture falling out.

2824. Mohr's Bottle for Caustic Alkaline Test Liquors, Fig. 2824, 30-ounce size, with tube to contain the mixture for retaining carbonic acid, and delivering syphon with pinchcock, 2s. 6d.

Large bottles can be fitted up in this style for use in chemical manufactories. See examples of the proper arrangement in Figs. 2690 and 2693.

2825. Mohr's Apparatus for Storing Test Liquors, and for filling Burettes from below, 30-ounce size, Fig. 2824, with addition of a Blowing Ball, 3s. 6d.

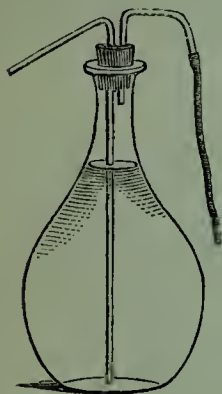
This consists of the apparatus represented by Fig. 2824, with the addition of a 3-inch caoutchouc blowing ball, like that represented in Fig. 2733. This is fixed on the top of the chloride of calcium tube of Fig. 2824. The syphon of this apparatus is then placed in connection with the fittings represented in Figs. 2692 and 2693. The burette is assumed to be fixed in a stand. By opening the pinchcock connected with the T piece, *b* Fig. 2692, and at the same time pressing the ball fixed on the apparatus, No. 2824, the solution is forced from the flask up into the burette.

2826. Mohr's Bottle for filling Burettes with solution of permanganate of potash, iodine in iodide of potassium, and similar tests, represented by Fig. 2826, one pint size, 2s.

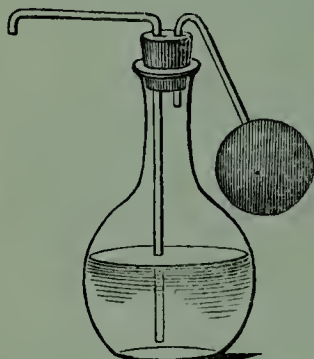
2827. Another kind, with Blowing Ball, Fig. 2827, one pint size, 3s.



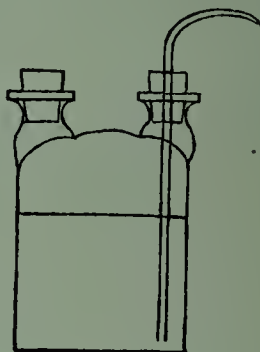
2824.



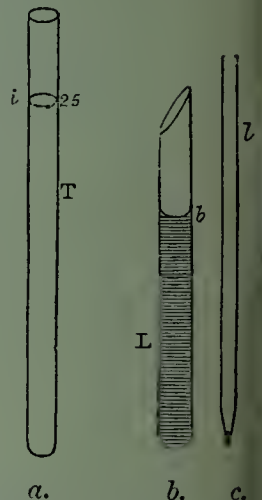
2826.



2827.



2828.

*a.**b.**c.*

2828. Gay-Lussac's Apparatus for filling tube measures with arsenical and other poisonous solutions, 20-ounce bottle with two necks and syphon, Fig. 2828, 2s.

a and *b* represent tube measures, into which the liquor is decanted by the syphon tube. The exact quantity is adjusted to the mark by the small pipette *c*, or by a particular inclination given to the tube in reference to the bottle, by which an excess of solution can be made to run back into the bottle.

2829. When bottles that are only partially filled with graduated solutions remain for some time unmoved, and especially when they happen to be in a warm situation, water rises in vapour from the solutions and condenses on the sides of the bottle, by that means giving greater concentration to the solution. The liquor in such bottles should be shaken before any is poured out for use.

It seems scarcely necessary to say that burettes, pipettes, and all vessels that serve to measure graduated liquors should be used in a *clean* and *dry* condition. When the form of a vessel is such as to render the drying of it tedious,—as it is, for example, with Binks's burette, Fig. 2736—the vessel, after being washed with water and drained, should be well rinsed with a little of the liquor that is next to be used with it.

All graduated vessels should be washed clean and dried immediately after use.

APPARATUS FOR SPECIAL OPERATIONS IN VOLUMETRIC ANALYSIS.

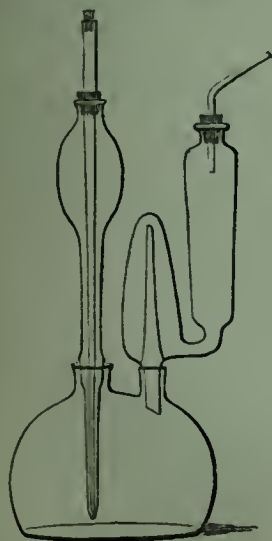
APPARATUS FOR THE ANALYSIS OF CARBONATES.

2833. The plan of the analyses that are executed with the help of these instruments is as follows :—In one part of the apparatus a given weight of the carbonate to be analysed is placed ; in another part, a quantity of sulphuric or nitric acid. The whole is weighed. The acid is then made to flow gradually upon the carbonate, so as to disengage carbonic acid gas. This gas is made to pass either over dry chloride of calcium, or through strong sulphuric acid, in order that it may be deprived of its water, and pass away in a dry state. When the action is completed, and the flasks are cool, they are wiped dry and again weighed. The loss of weight shows the weight of the discharged carbonic acid, and as the weight of the analysed carbonate is determined at the commencement of the process, its composition can thence be readily calculated. When the carbonates are alkalies, they may be decomposed by sulphuric acid ; but when they are earths, they require nitric acid,—that is to say, the apparatus must then be so contrived as to contain nitric acid for decomposing the carbonate, and sulphuric acid to dry the disengaged carbonic acid gas. The figures on page 310 exhibit a variety of methods, which have been contrived by different chemists to fulfil these conditions. I distinguish them by the names of their inventors as accurately as I am able so to do.

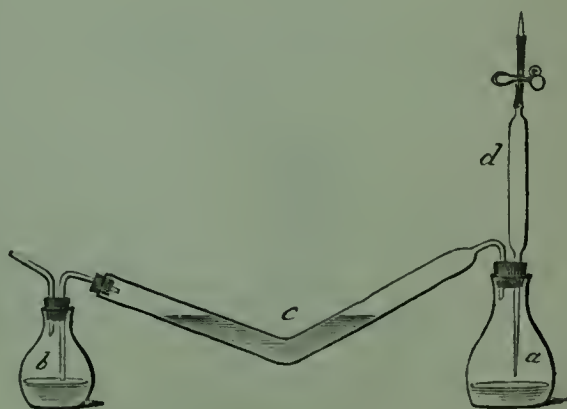
2834.	Fritzsche	1s.	2842.	Rose	5s.
2835.	Rose	1s. 6d.	2843.	Schaffner	2s. 6d.
2836.	„	1s. 3d.	2844.	Rohrbeck	5s.
2837.	Fresenius and Will	1s. 6d.	2846.	Kipp	6s.
2838.	„	2s. 6d.	2847.	Schrötter	6s.
2839.	Kipp	6s.	2848.	Erdmann	5s.
2840.	Mohr	3s.	2849.	Geissler	4s.
2841.	Rose and Berzelius	3s. 6d.			

Boxes to contain these Instruments, each 6d. to 9d. extra.

For detailed instructions for the analysis of substances containing carbonic acid, consult Mohr's *Titrirmethode*, 1862, page 87, and Fresenius's *Quantitative Chemical Analysis*, 1860, page 260.



2848.



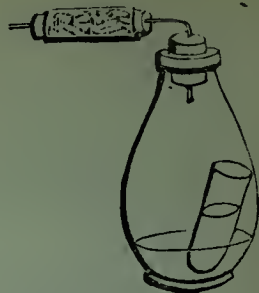
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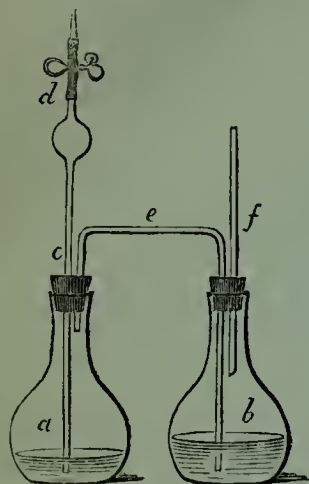
2834.



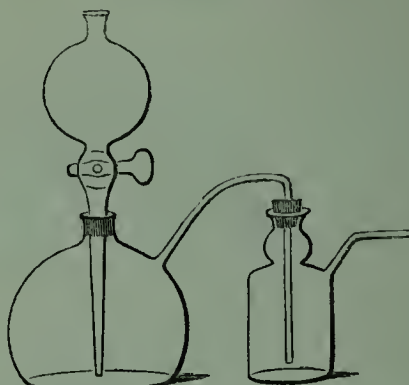
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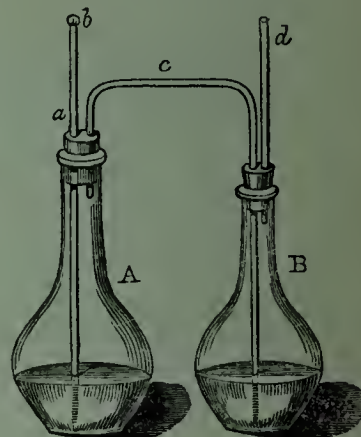
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2838.



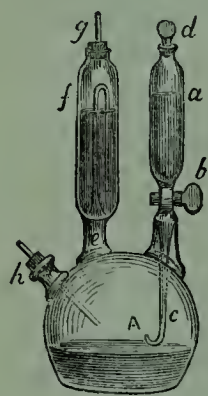
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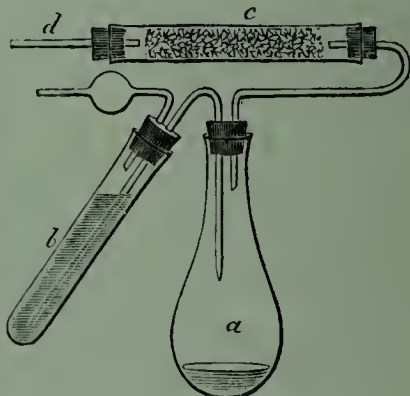
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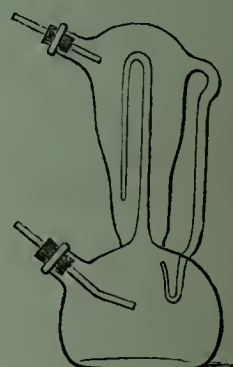
2840.



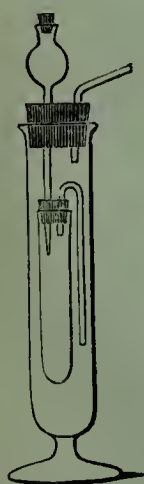
2844.



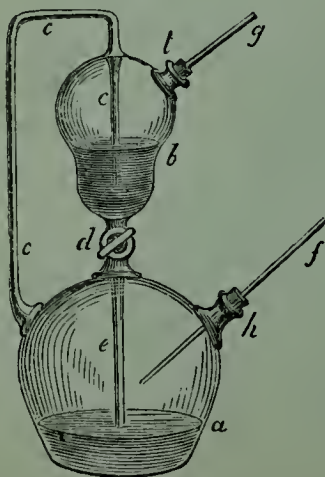
2841.



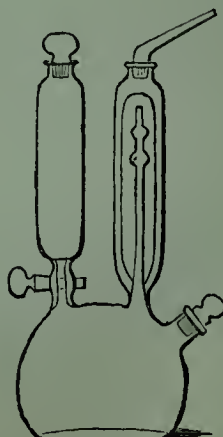
2842.



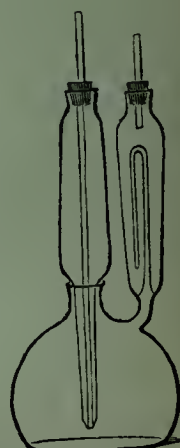
2843.



2846.



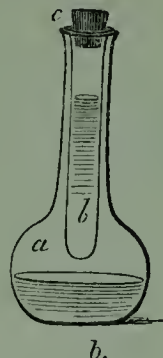
2847.



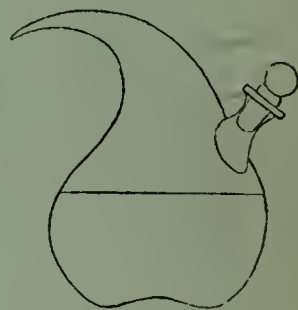
2849.

2854. MOHR'S APPARATUS for estimating CARBONIC ACID IN SOILS, Fig. 2854, 3s. 6d.

50 or 100 grains of soil are to be put into the flask *a*. The tube *d* is filled with hydrochloric acid. The tube *c*, with diluted caustic potash, containing caustic barytes. The acid from *d* is allowed to run gradually into *a*, whereupon carbonic acid is disengaged, and passes into the tube *c*, where it forms carbonate of barytes. When the hydrochloric acid is all out of the tube *d*, the pinchcock is opened, and air is sucked out of the bottle *b*, which brings all the carbonic acid from *a* into *c*. The carbonate of barytes is washed into a flask, boiled with water, and washed on a filter; after which it is estimated by graduated nitric acid and soda, as described at No. 2935 *a*. See Mohr's *Titrimethode*, 1862, page 481.

2855. GRIFFIN'S APPARATUS for the ANALYSIS of CARBONATES, Fig. 2855, *a* or *b*, each 1s. 6d.*a*.*b*.

2855.



2856.

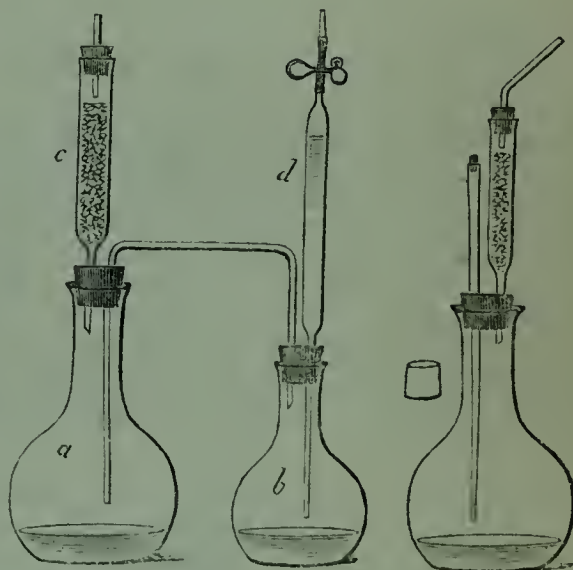
The process is described in detail in "*Chemical Recreations*," at page 113. In the flask *a* as much volumetric nitric acid is placed as will dissolve 10 grains of pure calc-spar. The tube *b* holds cold water. *c* is a cork for lifting the tube. 10 grains of the limestone to be tested, in coarse grains, are gradually dropped into the flask. After solution, the acid is boiled to expel the carbonic acid, and the superfluous nitric acid is then tested volumetrically. The process requires only one weighing; it is rapid, and gives accurate results.

2856. Schuster's Alkalimeter, for analyses by means of weighed test liquors; 2 ounces, stoppered, 2856, 9d.

2857. Mohr's Apparatus for the estimation of Carbonic Acid by expulsion from carbonates, absorption by ammonia, conversion into carbonate of calcium, and analysis by nitric acid, Fig. 2857, 3s. 6d.

The operation is described in detail in Mohr's *Titrimethode*, 1862, page 95; and in Fresenius's *Quantitative Chemical Analysis*, 1860, page 268.

2858. Mohr's Apparatus for the estimation of MANGANESE by the oxalic acid process, Fig. 2858, 2s. 6d.



2857.

2858.

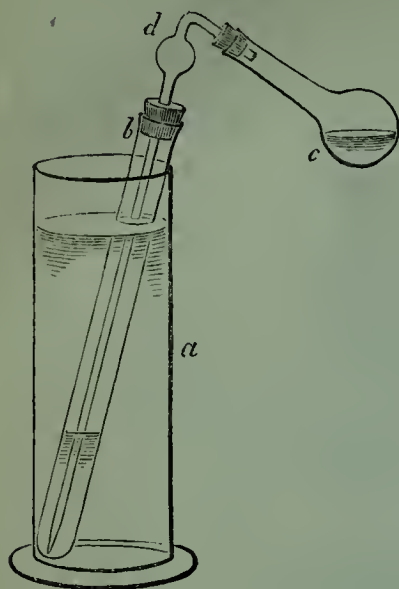
See Mohr's *Titrimethode*, page 495.

2859. Mohr's Apparatus for distilling CHLORINE into a solution of Iodide of Potassium, in order that the separated Iodine may be tested with Hyposulphite of Soda, Fig. 2859. The flask *c* is of 2 ounce size; the condensing tube *b* is 14 inches long by 1 inch wide; the cylinder *a* is 15 inches high by 3 inches wide. The set, 5s.

2860. Another form of Mohr's Apparatus for the distillation of Chlorine and liberation of Iodine, Fig. 2860. The two flasks and tubes, but without the support and lamp, 3s. 6d.

The use of this apparatus is explained in Fresenius's *Quantitative Chemical Analysis*, page 283.

2861. Fresenius's Apparatus for the distillation of Chlorine into Iodide of Potassium.
Fig. 2861, 2s. 6d.



2859.

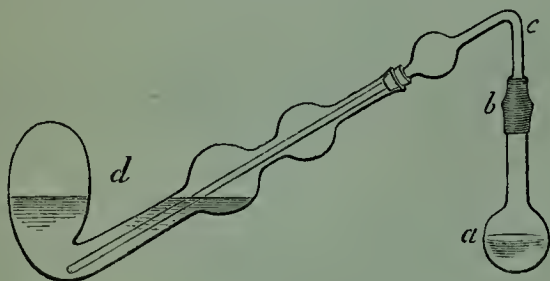


2860.

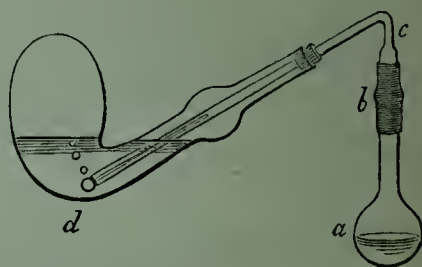
2862. Bunsen's Apparatus for the distillation of Chlorine, Fig. 2862, 2s. 6d.

2862 a. The apparatus Nos. 2859, 2861, 2862, are described in MOHR'S *Titrimethode*, page 23.

Testing of Peroxide of Manganese.—The testing of peroxide of manganese is a process that explains the use of the above distilling apparatus. A small quantity of manganese, such as grains, or 8.7 grains ($= \frac{1}{5}$ atom), or 0.436 gramme when CC. measures are used, is boiled in a small flask with concentrated hydrochloric acid. Chlorine gas is given off, and passes into the receiver, to be absorbed by a solution of iodide of potassium, in which it produces chloride of potassium, and sets iodine free. There must be present enough of the iodide of potassium, not only to supply the free iodine, but also to keep it in solution,—about 10 parts of iodide for 6 parts of oxygen. When the distillation is ended, the iodine is estimated by a solution of hyposulphite of sodium, such as Nos. 2944, 3008, or 3054. The quantity of iodine being determined, its equivalent in chlorine and in pure peroxide of manganese, is calculated. See No. 2945 a.



2861.



2862.

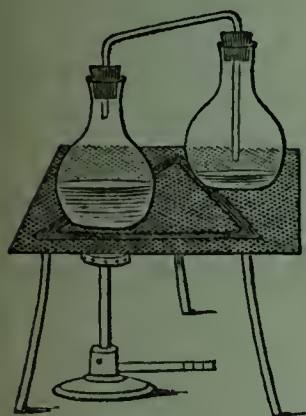
APPARATUS to be used for preparing a SOLUTION OF IRON in an Acid, without permitting the iron to pass into the ferric condition:—

2863. Mohr's Flask, with tube and caoutchouc valve, which permits the outward passage of the hydrogen of the dissolving acid, but not the inward passage of air. 5-ounce size, Fig. 2863, 1s.

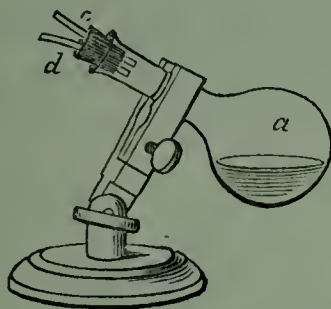
2864. Mohr's Apparatus, consisting of a pair of Flasks, connected by a glass tube. The hydrogen escapes through water placed in the second flask, Fig. 2864, The pair of flasks and connecting tube, 1s. 6d. Price of the tripod, 10-inch, 1s. 6d. The gauze, 10-inch, 1s. The gas burner, 2s. 6d.

2865. Fresenius's Flask, with a pair of gas tubes, Fig. 2865; by which arrangement a constant current of carbonic acid gas is passed through the flask during the solution of the iron; the tube *d* being connected with a carbonic acid apparatus, such as is represented by Fig. 2869 or 2870. Price of flask and tubes, 1s.

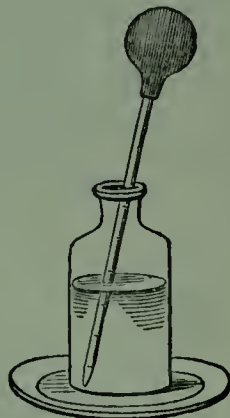
The Support is priced at No. 315.



2864.



2865.



2866.

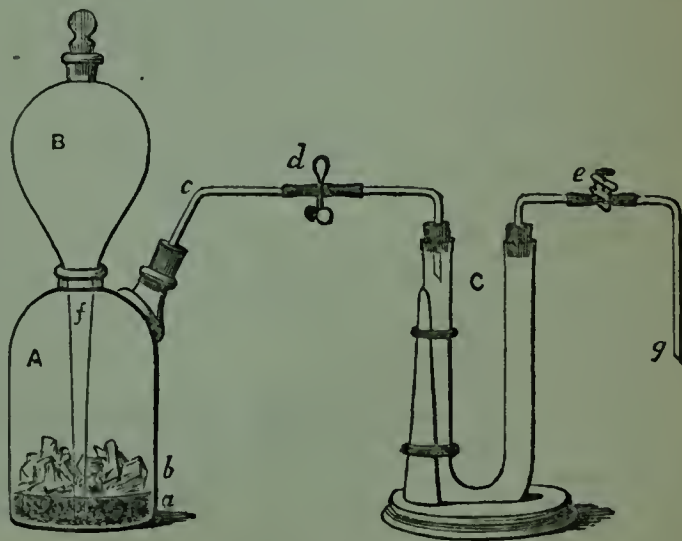


2863.

2865 a. Assay of Iron Ores.—A solution of an iron ore is prepared in hydrochloric acid, or in proto-hydrochloric acid; and this solution is tested either by the potassium bichromate solution or by a potassium permanganate solution. The quantity of iron ore to be taken for analysis depends upon the test liquor that is to be used. It may be as much as is supposed to contain 5 or 10 grains; or 0.28 or 0.56 grammes of iron. The ore is dissolved in one of the flasks described above, so as to avoid the formation of ferric salt, because only ferrous salt is acted on by the permanganate and chromate tests. See No. 2955.

2866. Graduated Tube and Blowing Ball, for supplying a regulated quantity of sulphuric acid to substances that are to be tested with permanganate of potassium. Fig. 2866. See No. 2955, 2s. 6d.

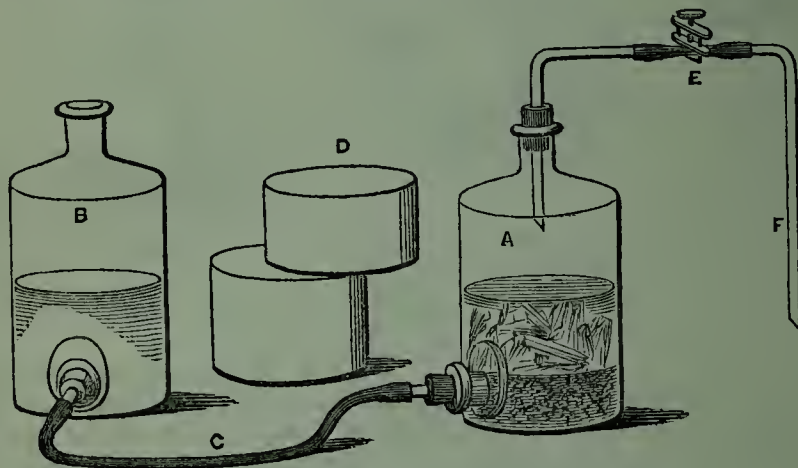
2869. GAS APPARATUS for supplying a regulated and continuous current of Carbonic Acid gas or of Hydrogen gas, when required for an Analytical operation. Form of Fig. 2869. Contents of Gas Bottle, 1½ pint; the tube C 12 inches long, 1 inch wide, mounted on a black wood support, with pinchcock *d* and clamp *e*, No. 2871, fitted together as in Fig. 2869, 10s. 6d.



2869.

2869 *a*. This apparatus consists of a Woulff's Bottle, A, with two necks, adapted to a long globular funnel B, and to a gas-delivery tube, *c, g*, which may have, or not have, according to necessity, in its course one or two washing or drying tubes C. The neck *f*, of the funnel B passes to the bottom of the bottle A; and this bottle contains, *first*, a stratum of small flint gravel about $1\frac{1}{2}$ inch in depth, and upon that the pieces of zinc or marble, which, when acted on by the diluted acid, are to produce the required gas. The gas-delivery tube *c, g*, contains one or two caoutchouc tubes, upon which are placed a Mohr's pinchcock *d* (No. 2692), and a clamp or pinchcock *e* (No. 2871). When the bottle is supplied with acid, and the pinchcocks are both open, the gas escapes through the tubes in the direction *c, d, C, e, g*. When the pinchcock *d* is closed, the gas, not being able to escape, accumulates in the bottle A, and drives back the acid up the tube *f* into the funnel B, and the action then ceases, because the gravel at *a* separates the acid from the metal placed at *b*. If the pinchcock *e* is then screwed up to such an extent as to permit only a limited passage of gas, more or less as you may desire, and the pinchcock *d* is opened and removed from the caoutchouc tube, the acid descends from the funnel B to the bottle A, and as much gas is produced as the pinchcock *e* permits to escape, but not more, because any pressure of gas in A causes the acid to ascend into B. Hence a regulated current of gas is produced.

2870. Deville's Gas Generator, for preparing a continuous current of HYDROGEN GAS, CARBONIC ACID, &c., for use in Analytical processes, Fig. 2870, consisting of 2 bottles each of 1 litre, or $1\frac{3}{4}$ pints capacity, with pinchcock No. 2871, 2 feet of caoutchouc tube and fittings, 8s.



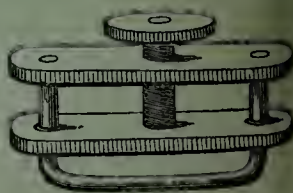
2870.

The Blocks D are priced at page 37. 5-inch blocks suit best.

The bottle A is filled to above the tubulure with small siliceous pebbles, or, failing them, with bits of coke. Above that bed is placed a quantity of granulated zinc (for hydrogen), or of chips of marble (for carbonic acid). The flask B contains diluted sulphuric acid. The flasks are connected by the flexible tube C. When the bottle A is placed upon the blocks D, above the level of the acid in the bottle B, there is no action. When the bottle B is placed on the blocks and the bottle A on the table, the acid descends into the bottle A, rises through the flints, and disengages gas by action on the zinc or marble. But this action is regulated by the clamp E, which is represented of its full size by Fig. 2871. When this is closed, and the joints of the apparatus are tight, the acid cannot descend. When the pinchcock is opened, or partially opened, the acid descends more or less and produces the gas with any desired degree of rapidity. The pressure of the acid is regulated by the height of the blocks D, upon which the bottle is raised; the force of chemical action by the state of dilution of the acid. A useful strength is 25° (see No. 2901), which is about 1 part of oil of vitriol to 10 parts of water.

2870 *a*. Small sea gravel, suitable for the supply of the above gas bottles, *per quart*, 6d.

2871. BRASS CLAMP for regulating the passage of Gases or Liquids through flexible tubes, form and size of Fig. 2871, 1s.



2871.

This clamp is exhibited in use in Figs. 2869 and 2870. The flexible tube is pressed between the lower wire and the middle plate, which is moved by the screw.

CLARK'S WATER TEST.

The Commissioners of Woods and Forests require, as one of the indispensable conditions to a Bill for supplying water to a town being presented by them to Parliament, that there shall be given, in reference to the waters already supplied to the town, as well as in reference to the waters proposed to be supplied,—

“A statement of the quality of the water as exhibited by chemical analysis, specifying its adaptation for domestic and manufacturing purposes, and its degree of hardness with reference to the Tests and Scale of Dr. Clark.”

The water-works sanctioned by the Board of Health have all the waters submitted to the same tests.

The process invented by DR. CLARK for DETERMINING THE HARDNESS OF WATERS is of easy execution, and of such extreme precision as to rank among the most exact and delicate operations of chemical analysis. The circumstances above referred to render this process of great interest, not only to professional chemists, but to engineers, manufacturers, and the public.

2872. SOLUTIONS AND APPARATUS FOR CLARK'S WATER TEST.—

Made in strict accordance with Dr. Clark's instructions.

1. FOR TESTING THE HARDNESS OF WATER.

1. SOAP TEST, standard strength, 4s. per pint, in a bottle.
2. STANDARD SOLUTION, WATER of 16° of HARDNESS, 2s. per pint, in a bottle.
3. GRADUATED BURETTE, for measuring the quantity of Soap Test, or the Test for Alkalinity, used in each analysis. Graduated into Test Measures, (each = 10 grains of water), and every Test Measure (degree) divided into 5ths, form of Fig. 2872, 3. *The following varieties:—*
 4. Contents, 16 Test Measures in $\frac{1}{2}$ ths, 3s. 6d.
 5. Contents, 20 Test Measures in $\frac{1}{2}$ ths, 3s. 6d.
 6. Contents, 32 Test Measures in $\frac{1}{2}$ ths, 4s.
 7. Mahogany Foot for the Graduated Pouret, Fig. 2872, 7, 1s. 6d.
8. Pipette to deliver 100 Test Measures of Water (= 1000 grains,) Fig. 2872, 8, 1s. 9d.



2872, 7.



2872, 3.

When the Pipette is emptied, the drop of water at the beak must be *drained* out, as it belongs to the measured quantity. It must not be *blown* out, for that alters the quality of the water, by introducing carbonic acid.

9. Set of Six Stoppered Bottles, with glass Stoppers, accurately fitted, for mixing the water with the Soap Test. Fig. 2799. *Per set*, 4s.
10. Bent Tube for sucking Carbonic Acid from the Bottles, 2d.
11. Five-Minutes Sand Glass, 3s. 6d.

2. FOR TESTING THE ALKALINITY OF WATERS.

12. Berlin Porcelain Evaporating Basin, in which to simmer the water when under trial for Alkalinity, diameter $8\frac{1}{2}$ inches, contents 1 quart, 2s. 8d.
13. MEASURE to Deliver ONE PINT of WATER, when drained *two minutes*, 2s. 3d.
14. IRON TRIPOD, for supporting the Evaporating Basin over a Spirit Lamp, 1s. 3d.



2872, 17.



2872, 8.



2872, 21.

CLARK'S WATER TEST APPARATUS, *continued*:—

15. Glass Spirit Lamp, with Chimney, complete, 1s. 6d.
16. Two Glass Stirrers, 3d.
17. Set of Six Clark's Test Glasses, Fig. 2872, 17, page 315, 1s. 6d.
18. Pipette, 3d.
19. TEST FOR ALKALINITY, 2s. *per pint bottle*.
20. LITMUS TEST PAPER, 2s. *per dozen Books*.
21. Globular Flask, contents one gallon, with a Condenser attached. For boiling water in such a manner as to effect the decomposition of Bicarbonates without permitting the escape of steam, Fig. 2872, 21, 9s.
22. SPECIFICATION of the PATENT granted to PROFESSOR CLARK for a new method of rendering certain Waters (the water of the Thames being amongst the number) less impure and less hard, for the supply and use of manufactories, villages, towns, and cities, with an APPENDIX on the Method of Testing Waters, *sewed*, 1s.
23. Instructions for Performing the Testing operations, 1s.

ASSAY OF MILK. LACTOMETER. CREMOMETER.

2873. When new milk is set at rest for a period of from twelve to twenty-four hours, the cream separates from the other ingredients and rises to the surface of the liquor. If the operation is performed in cylinders of glass, the thickness of the layer of cream can be seen distinctly. If the glass cylinder is graduated into 100 parts, and is filled with the new milk up to 0°, the amount of cream can then be read off in *percentages*, from which it is possible to calculate the total quantity of cream that is contained in the milk of a given cow, as taken at one milking, well mixed and measured.

The graduated glass instrument used for this purpose is commonly called a LACTOMETER. The usual form of this instrument is a cylinder on foot like Fig. 2746 *a*, and sometimes a tube without foot, like Fig. 2326; but a form much to be preferred is that of the test mixer, Fig. 2790, or the graduated bottle, Fig. 2793.

The cream rises more readily in a short wide vessel, such as No. 2874 *f*, than in a long narrow one; but being then spread over a broader surface of liquor, it is not so easily measured. The larger the quantity of milk operated upon, the more trustworthy is the result; but a very good result is obtained by using a test mixer, Fig. 2790, of the capacity of a decigallon, and having a diameter of nearly two inches. A stoppered vessel is preferable to an open one, as it cuts off atmospheric influences, and in hot weather lessens the chance of the souring of the milk during the separation of the cream. The lactometer should be set aside, if possible, in a situation where the temperature is about 50° Fahr.; and it is better to place it up to the shoulder in cold water. When unstoppered tubes are used, they should be corked and plunged into water, and a cover, dipping into the water, be placed over them, to cut off the access of air.

Although it is impossible to say what ought to be the percentage of cream in genuine milk, may be safely said that if it prove to be under 5 per cent., the deficiency may be attributed to dilution with water.

2874. GRADUATED LACTOMETERS.

- 2874 *a*. Stoppered Lactometer, form of Fig. 2790, capacity 1 decigallon, 6s.
- 2874 *b*. Tube without foot, with 15 degrees, graduated at the upper part, 2s.
- 2874 *c*. Set of Three such tubes in a zinc water cistern, with cover, 10s.
- 2874 *d*. Cylinder on foot, similar to Fig. 2746 *a*, with 15 degrees, graduated at the upper part, 2s. 6d.
- 2874 *e*. Similar Cylinder, with glass stopper, Fig. 2746, with 15 degrees, graduated at the upper part, 3s.
- 2874 *f*. Short, wide Cylinder, 6 inches long, and 1½ inch wide, on foot with spout with 15 degrees, graduated at the upper part, 2s.

Instruments for determining the specific gravity of milk have been described at page 57.

2875. THE LACTOSCOPE, or OPTICAL MILK-TEST.—Consisting of a glass trough Fig. 2875, a glass cylinder on foot with spout, of about 300 Septems capacity, with a mark to show the measure of 100 Septems, and a pipette holding 10 Septems, graduated to show ½ Septems. *The set*, 7s. 6d.

2875 *a*. The Trough, Fig. 2875, *alone*, 4s.

Fig. 2875 represents a vessel with parallel glass sides, mounted in a brass frame. The width between the glass plates is $\frac{1}{2}$ inch. When this vessel is filled with a mixture of new milk and water, and the appearance of the mixture is examined by placing a candle at three feet distance from one side of it, and your eye close to the other side, the presence of a *certain proportion of cream* renders the figure of the candle flame indistinct. The smaller the quantity of milk required to produce this indistinctness, the better is the quality of the milk.



2875.

Operation.—Fill up the cylinder to 100 Septems with water. Add to the water by means of the pipette, say 3 Septems of the milk that is to be tested. Shake the mixture well; fill with it the glass trough, and examine the candle flame by looking through the trough. In doing so, your back must be turned against the window of the room. If the candle flame is clearly seen, the mixture is to be returned to the cylinder, mixed with one more Septem of milk, again agitated, and again returned to the trough to be tried against the candle flame. This must be repeated, adding at each time either 1 Septem or $\frac{1}{2}$ Septem, until the candle flame disappears, which occurs somewhat suddenly. When this point is determined, you have to reckon the number of Septems of milk added to the 100 Septems of water to produce this result. The less milk needed for the purpose, the greater is the proportion of cream or butter that it contains. The following Table by VOGEL (the inventor of this Lactoscope) shows the percentage of butter, corresponding to different quantities of milk made use of for this mode of trial.

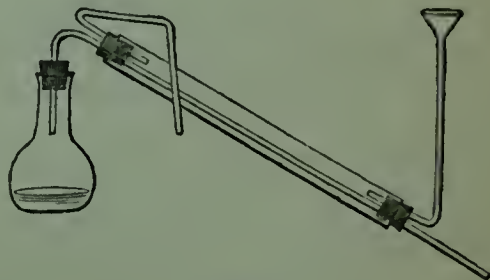
Column M represents the Septems of Milk used; Column B the Percentages of Butter indicated in that Milk.

M	B	M	B	M	B	M	B	M	B	M	B
1	23.43	4 $\frac{1}{2}$	5.38	8	3.31	13	2.01	20	1.39	40	0.81
1 $\frac{1}{2}$	15.46	5	4.87	8 $\frac{1}{2}$	2.96	14	1.88	22	1.28	50	0.69
2	11.83	5 $\frac{1}{2}$	4.45	9	2.80	15	1.78	24	1.19	60	0.61
2 $\frac{1}{2}$	9.51	6	4.09	9 $\frac{1}{2}$	2.77	16	1.68	26	1.12	70	0.56
3	7.96	6 $\frac{1}{2}$	3.80	10	2.55	17	1.60	28	1.06	80	0.52
3 $\frac{1}{2}$	6.86	7	3.54	11	2.43	18	1.52	30	1.00	90	0.48
4	6.03	7 $\frac{1}{2}$	3.32	12	2.16	19	1.45	35	0.89	100	0.46

According to the examination of the milk of 4 cows, the Septems of milk used were, maximum 5.8, minimum 2., mean 3.7. Another set of 4 cows, maximum 5.3, minimum 3.4. Another set of 7 cows, maximum 9, minimum 3, mean 6.2. These results range from 2.80 to 11.83, or nearly from 3 to 12 per cent. of butter, a very wide range; which, assuming the experiments to be correct, how clearly the necessity incumbent upon dairy farmers to examine the produce of their cows vigilantly.

But, however useful this apparatus may be for such investigations and comparisons as the above, it fails to effect the commercial purpose of detecting the adulteration of milk with water; for it is clear that the milk of one cow, diluted with 100 per cent. of water, may still be as rich in butter as the milk of another cow presented in its genuine condition. Nevertheless, there is this point of certainty in the method, that if you fix upon a given quality, say 4 per cent. of butter, which is indicated by a mixture of

Septems of milk with 100 Septems of water, it is always easy to determine whether any given sample of milk is above or below this standard.



2876.

876. Apparatus for the distillation of small quantities of liquor, such as alcohol from wines, ammonia from gas liquor, &c., fig. 2876. Flask 3 to 5 ounces, wide tube 10 inches by $\frac{3}{4}$ inch. The set, 3s.

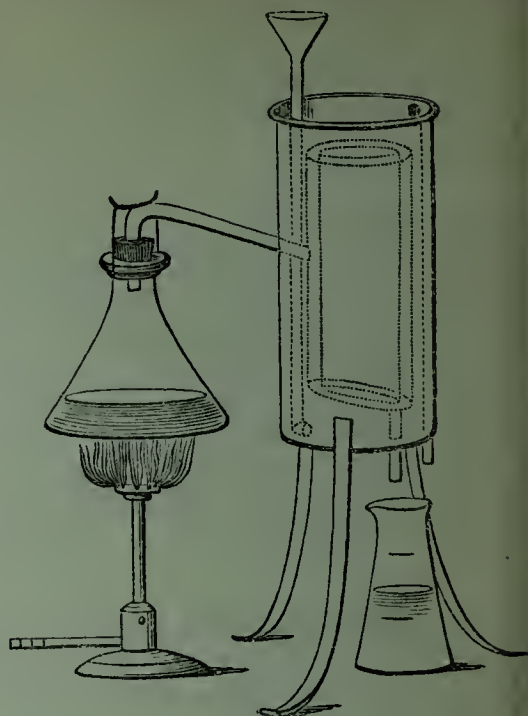
2877. STILL FOR THE SEPARATION OF ALCOHOL FROM WINES, consisting of a Glass Still, pint size, a Copper Condenser, and a glass receiving jar, graduated to show $\frac{1}{4}$ pint, $\frac{1}{2}$ pint, 3000 grains, or any desired quantity. *The set*, 21s.

Price of the Gas Burner, No. 978, 5s.

The Condenser is constructed on the plan described at length at No. 1914, page 209. The body of the condenser, made of zinc, measures 11 inches by 5 inches; the legs are 8 inches long. The interior cylinder of the condenser is made of copper, $3\frac{1}{2}$ inches in diameter, with $\frac{1}{2}$ inch space between its two walls. The glass still is made flat at the bottom, to afford space for the intumescence of the distilled liquors. The distilled jar serves to measure the wine, and to receive the distilled alcohol. It can have engraved upon it any two marks which the purchaser may desire, expressing grains, fluid ounces, parts of a pint, or parts of a litre.

In a special article on the chemical analysis of wines, I shall describe another form of Still and Condenser, with which less than a fluid ounce of wine can be tested for alcohol.

The present apparatus can also be used for the preparation of distilled water.



2877.

2878. GEISSLER'S PATENT VAPORIMETER, for estimating the Percentage of Alcohol contained in Wine, Beer, fermented Must, Vinegar, &c. The principle of this apparatus is, to convert a spirituous liquor into vapour by the heat of the steam of water, and to make the spirituous vapour force a column of mercury up against an engraved scale. Upon observing the level of the mercury on the scale, and the degree of temperature shown by the attached Thermometer, and referring these particulars to the printed Tables, it is easy to calculate the *Percentage by Volume*, according to Tralles, of the alcohol contained in the liquor submitted to trial. 45s.

2879. CHEMICAL TESTING of WINES. A SET of APPARATUS and TEST SOLUTIONS, for determining the following particulars respecting any sample of Wine:—

1. The quantity of FREE ACID in the Wine.
2. The percentage of ALCOHOL.
3. The percentage of SUGAR.
4. The percentage of EXTRACT, or solid residue left by evaporation at 230° Fahr.
5. The percentage of fixed alkaline SALTS.

The Apparatus will be accompanied by a book containing precise directions for performing the experiments, with Tables for reducing the calculations to the greatest simplicity.

The Apparatus for Testing the Acidity, Sugar, or Alcohol of Wines, may be purchased separately.

2880. ECONOMY IN SUGAR-MAKING: a COLLECTION of APPARATUS and CHEMICAL TESTS for Testing the Quality of the Juice of the Sugar Cane, &c., so as to determine the exact quantity of Quicklime required to temper a given quantity of Cane-Juice, in order to produce the greatest amount of the best sugar. According to Dr. JOHN SHIER.

2881. DIRECTIONS FOR TESTING CANE-JUICE, with Practical Instructions for conducting the process of Clarification. By JOHN SHIER, Esq., LL.D., late Agricultural Chemist to the Colony of British Guiana. Illustrated with numerous wood cuts, price 3s.

This work contains full details for conducting the process of Testing, which is very simple, and such as can be followed by the workmen on a sugar estate.

THIS APPARATUS CONTAINS THE FOLLOWING ARTICLES:—

Thermometer, with scale on milk glass, to 350° Fahr.

Twaddell's Hydrometer, No. 1, degree 0° to 24°, or spec. grav. 1000 to 1120; ditto, No. 4, degree 74° to 102°, or spec. grav. 1370 to 1510, graduated at 84° Fahr.

Two Solution Jars, for use with the hydrometers.

Pan, to hold the solution jars.

Glass Funnel, Funnel Holder, 100 Paper Filters in a case, and two pieces of Muslin, for straining the Cane-Juice.

Glass Measure for 250 Septems, or the 40th part of a gallon.

Graduated Burette for measuring the Test liquors, 100 Septems in 100°, with a support.

Furnace for Boiling the Cane-Juice rapidly; consisting of a glass spirit lamp, with supply of wick, a tin-plate furnace cylinder, with door to put round the lamp, and a larger cylinder to

cut off draughts of air, being the form of furnace which Dr. Shier found most useful in Demerara.

Tin-plate Case, with 100 Lucifer Matches.

Stoppered Bottle, $\frac{1}{10}$ th gallon, for Spirits of Wine.

Set of four Bohemian-beaked Tumblers, in which to boil the measured Cane-Juice.

Bottle, $\frac{1}{10}$ th gallon, with Lime Water.

Bottle, $\frac{1}{10}$ th gallon, filled with pure Lime.

Bottle, with 12 books of best Litmus test paper.

Pocket Case, with 1 book of Litmus test paper.

Six Test Glasses, a pipette, 6 glass stirrers, and a rest for pipettes and stirrers.

CABINET, with Lock and Key, made with a drawer and divisions, in which this apparatus is arranged for convenient use, and for travelling with safety. Size of the Cabinet, 18 inches long, 12 inches wide, 11 inches high.

2882. Price of the Collection, when the Cabinet is of polished mahogany, £4 4s.

2883. Price, when the Cabinet is of pine wood, stained black, £3 10s.

2884. Price of a Packing Case to contain the Cabinet, for transport by sea, *if lined with tin*, 10s.

2885. Packing Case, when not lined with tin, 4s.

The following ADVERTISEMENT, issued when Dr. SHIER's Book, and this Collection of Apparatus were first published, shows what may be expected from the use of this process of Testing:—

CONTENTS OF THE BOOK, No. 2881.

PART I.—REPORT ON THE CLARIFICATION OF CANE-JUICE. *Addressed to His Excellency Henry Barkly, Esq., Governor of the Colony of British Guiana.*—Introduction.—Process of Straining Cane-Juice.—The Hydrometer.—Processes of Clarification, with their Defects: *a.* By Cold Tempering; *b.* By Cracking; *c.* By Bisulphite of Lime; *d.* By the New Chemical System, regulated by Checks and Tests.—Tables showing the Correspondence of Degrees of Baumé's and Twaddell's Hydrometers, with the Specific Gravities of Solutions.—Table of Solutions of Sugar.

PART II.—PRACTICAL DIRECTIONS FOR TESTING CANE-JUICE, SO AS TO DETERMINE THE EXACT AMOUNT OF QUICKLIME REQUIRED TO TEMPER A GIVEN QUANTITY OF CANE-JUICE.

PART III.—DESCRIPTION OF THE CHEMICAL APPARATUS RECOMMENDED FOR USE IN COLONIAL SUGAR WORKS. Illustrated by Wood Engravings.

The REPORT on the CLARIFICATION OF CANE-JUICE, addressed by Dr. SHIER to the Governor of British Guiana, is now reprinted, to accompany a collection of CHEMICAL APPARATUS, which has been prepared on a plan arranged by Dr. SHIER, for the use of PLANTERS who may be inclined to adopt his improved process of CLARIFICATION.

In order to render the operation of TESTING as intelligible as possible to those not well acquainted with Chemical Experiments, Dr. SHIER drew up, during his visit to England, the PRACTICAL DIRECTIONS FOR TESTING CANE-JUICE, which form the Second Part of this work; and, at his desire, there has been added, an illustrated description of the Apparatus and Materials that are required to carry his method of TESTING into operation.

It has been well ascertained in Britain, that the beneficial produce of Chemical Works is greatly increased when the details of the manufacturing processes are regulated scientifically; and, it is but reasonable to expect, that the regulation of Colonial Sugar Works, by scientific processes, would also prove advantageous. But, it will probably surprise the **PLANTER**, who is ignorant of chemical phenomena, to find the performance of so simple and easy a process, as that recommended by **Dr. SHIER**, leading to so important an improvement as an increase of *One-fifth* in the Produce of Sugar, without any increase in the Expense of Manufacture,—no change being required in the arrangement of the Coppers and other Apparatus now in use. The result is one that will no doubt excite the attention of all who are interested in the prosperity and profits of Sugar Estates.

“We beg to direct the attention of our Sugar-making friends to the Advertisement relative to **Dr. Shier's Apparatus for Testing Cane-Juice, &c.** If it only effects one-tenth of the benefit promised, it will be cheap at one hundred fold the advertised cost.”—*From the BARBADOS GLOBE.*

The *actual beneficial results of the process* are stated in the following summary, contained in the **OFFICIAL REPORT**, presented by **Dr. SHIER** to his Excellency **GOVERNOR BARKLY**:—

“By following this method, I have prepared many specimens of sugar from canes of various sort and from many different localities in the colony. These samples have been transmitted to London, Glasgow, and other markets, to be valued, and have ranged from three shillings to eight shillings per cwt. above the average price of Demerara muscovado in the market at the time. But this is not all: in consequence of the saving of juice effected by the mode of clarification being such as admits of substituting subsidence and filtration for skimming, I obtained nearly twenty per cent. more of the juice than would have been got by the process as usually conducted, and the juice yielded from 1 lb. 4 oz. to 1 lb. 10 oz. of muscovado per gallon.”

2886. COLLECTION of APPARATUS and TESTS for the ANALYSIS of SUGARS and SYRUPS.

2887. MITSCHERLICH'S POLARISCOPE, or Optical Saccharimeter, Fig. 2886, £3 10s.

2888. INSTRUCTIONS for the TESTING of SUGARS by the Polariscopes, &c. In preparation for publication as a separate work.

ASSAYING OF METALS AND ORES.—SETS OF APPARATUS AND TEST SOLUTIONS for the Volumetric Analysis of solutions of iron, copper, zinc, tin, lead, &c., prepared to order. The following set for the Assay of Zinc is given as an example:—

2889. APPARATUS FOR THE RAPID ASSAY OF ZINC ORES FOR TECHNICAL PURPOSES. The zinc is tested by a solution of sulphide of sodium.

The operation is easily performed by a workman, and an analysis can be completed in less than an hour. *Price of the Set, 21s.*

The instruments enumerated in the following list are described and figured in this work at the numbers specified against each article.

2688, 30. Mohr's Burette, 100 Septems in $\frac{1}{2}$, 4s. 6d.

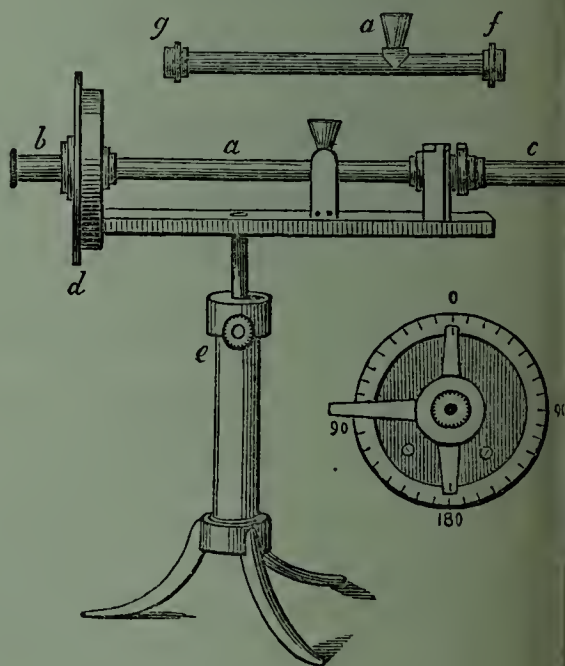
2702. Support for Mohr's Burette, 3s. 6d.

2783, 20. Bottle, to measure 1 Decigallon, or 1000 Septems, 2s.

2768, 17. Bulb Pipette, to deliver 10 Septems, 9d.

2768, 21. Bulb Pipette, to deliver 50 Septems, 1s. 3d.

2798, 10. Two Mixing Jars, pint size, with graduation at 5 ounces, 1s. 9d. each.



2887.

2818. Two Pipette Bottles, with Caps and Pipettes, 1s. each.
 2815 b. Porcelain Testing Slab, for Coloured Precipitates, 1s.
 1401. Pint Flask, for Preparing Solutions, 9d.
 2813. Griffin's Quick Filter, 3d.
 2814. Three Decanting Tubes, 6d.
 2768, 16. Small Pipette, 5 Septems, for adjusting measures, 6d.
 Detailed Instructions for performing the Analysis, 1s.
 The above set of Apparatus complete, 21s.

The following articles are required for carrying out this process. The necessary quantity of chemicals depends upon the contemplated activity of the operations.

424. Balance, 31s. 6d.
 445. Weights, 25s.
 51. Agate Mortar, 3 inch, 18s.
 870. Spirit Lamp, 16s. 6d.
 Sulphate of Zinc, per lb., 9d.
 Sulphide of Sodium, per lb., 4s.
 Ferric Chloride, per oz., 8d.
 Ferridecyanide of Potassium, per oz., 1s.
 Ammonia Carbonate, per lb., 2s.

- Ammonia, per lb., 9d.
 Hydrochloric Acid, per lb., 6d.
 Nitric Acid, per lb., 1s.

When Blende containing copper is to be tested, the following articles are required:—

2005. Sulphuretted Hydrogen Apparatus, 3s. 6d.
 Sulphide of Iron, per lb., 6d.
 Commercial Sulphuric Acid, sp. gr. 1·845 per lb., 2d.

Foreign orders should specify whether duplicates of the *breakable* glass apparatus are required.

VOLUMETRIC ANALYSIS ACCORDING TO THE BRITISH PHARMACOPŒIA.

2890. A. VOLUMETRIC SOLUTIONS.

These solutions are identical with the solutions described in the present work at the numbers cited below.

The PRICES include the cost of BOTTLES.

	No.	Pint.	Half-Gallon.
Oxalic Acid	3035	2s.	6s.
Soda	3040	2s.	6s.
Nitrate of Silver	3049	3s. 6d.	12s.
Hyposulphite of Soda	3054	2s.	6s.
Iodine	3055	2s. 6d.	7s. 6d.
Bichromate of Potash	3061	2s.	6s.

The composition of these solutions will be found on reference to the respective numbers.

2891. B. VOLUMETRIC APPARATUS.

The information given in the "British Pharmacopœia" on the subject of apparatus for volumetric analysis is as follows:—

a. "The tube used with the volumetric solutions is an Alkalimeter, which, when filled to 0, holds 1000 grains of distilled water at 60°, and is divided into 100 parts of equal capacity."

Each of the measures of 10 grains of water, is called in this work a *Decem*.

The following sentence explains the method by which the analyst is to measure the liquid that is to be submitted to volumetric analysis.

b. "One fluid drachm of sulphuric acid requires for neutralisation 206 measures of the volumetric solution of soda."

The "Pharmacopœia" does not define the word *measures* used in quotation b. I take it for granted that it means *Decems*, or measures of the bulk of 10 grains of water, similar to each of the hundred degrees on the scale of the test tube described in quotation a.

Neither does the "Pharmacopœia" inform us in what manner the "fluid drachm" is to be measured, whether in an ordinary conical fluid drachm measure, or how else.

Supposing it to be allowable to render the volumetric processes described in the "Pharmacopœia" more convenient in practice than it is possible for them to be, if the vague instructions which it gives are carelessly interpreted, I venture to recommend the adoption of the following instruments and numbers prefixed to which refer to descriptions and figures given in former articles of this work.

2688. Mohr's Burette, 100 Decems in $\frac{1}{10}$, 5s.
 2688. Mohr's Burette, 35 Decems in $\frac{1}{10}$ ths, 4s.
 2702. Support for Mohr's Burette, 3s. 6d.
 2736. Binks's Burette, 100 Decems in $\frac{1}{10}$, 5s.
 2738. Mahogany Foot for ditto, 1s. 6d.
 2768. Bulb Pipette, to deliver 1 fluid drachm, 1s.
 Measure divided into 10 fluid drachms, 2s.
 2769. Scale Pipette, 100 minims in $\frac{1}{10}$, 2s. 6d.
 2769. Scale Pipette, 1 fluid ounce in 8 fluid drachms, 2s. 6d.
 2798 c. Mixing Jar, half-pint, 10d.
 2798 a. Mixing Flask, half-pint, 7d.
 2815 a. Porcelain Testing Slab, for coloured precipitates. 1s. 6d.
 2813. Griffin's Quick Filter, 3d.
 2814. Decanting Tube, 2d.
 2817. Test Glass, half dozen, 9d.
 2423. Litmus Test Paper, 3 books, 6d.
2892. The Complete Set of Apparatus, £1 11s. 6d.
 2893. The Set of 6 Test Solutions, 1 pint each, 14s.
 2894. The Apparatus and Solutions together, £2 5s.

By Act of Parliament, the Imperial weights and measures are justified at 62° F., and the above vessels are graduated at that temperature. The "Pharmacopœia" prescribes 60°, which is a useless deviation from an established standard.

2894 a. Mohr's Burette can be used with all the test solutions, except that of iodine, which requires a burette without a caoutchouc tube. Binks's Burette can be used, not only with iodine, but with all the other solutions; but it is less convenient than Mohr's; and as the iodine solution is only rarely required, the most generally useful form of burette is Mohr's. The "Pharmacopœia" recommends the scale to be 100 Decems in 100 divisions; but it gives analyses with such results as 80·8, 84·74, 93·88, which read to hundredths of Decems. For analyses that require such close reading, it is better to use smaller quantities of liquors for analysis, and to apply the test solution with a smaller burette graduated to show 10ths of Decems.

2894 b. The quantity of liquor recommended by the "Pharmacopœia" for analysis is very frequently 1 *fluid drachm*. This quantity is absurdly large, when the liquid is concentrated. As shown in quotation b, 206 Decems of test solution are used in one experiment. That quantity demands three fillings of the burette; and if the process of testing is repeated, which is almost always necessary, there will be required six fillings of the burette, and a consumption of test soda amounting to 4120 grain measures, or nearly half a pint. To prevent this extravagance, it is only necessary to measure accurately 1 fluid drachm with a pipette, to dilute this with water to the bulk of 10 drachms, and to apply the test to 1 drachm of this mixture. Of course, the consumption of soda test will then be 20·6 Decems; and if great accuracy is required, this quantity is best estimated by means of a small burette which shows 10ths of Decems. The test can be easily repeated with the same diluted liquor, and an accurate result procured by the expenditure of only 41·2 Decems of soda test instead of 412 Decems, and this in less than a fifth part of the time that would have to be spent in literally obeying the instructions given in the Pharmacopœia.

The scale pipettes, showing minims and fluid drachms, are required for measuring out specific quantities of liquids for testing. Thus, with the minim pipette, you can measure out the *half*, the *quarter*, or any other aliquot part of a drachm; and, with the drachm pipette, you can readily and accurately measure such quantities as 2, 4, or 6 drachms, quantities which are frequently prescribed in the Pharmacopœia.

COLLECTIONS OF VOLUMETRIC APPARATUS FOR GENERAL USE.

2895. The applications of volumetric analysis are so numerous, and the variety of sorts and sizes of graduated instruments is so great, that it is impossible to make up a list of what could with any propriety be called "A SET" of Volumetric Apparatus. Every chemist, according to the special course of his researches, and every chemical manufacturer, according to the extent, the activity, and the accuracy of his operations, will require instruments directly suited to his peculiar processes; and these he must himself select. All that can be done in this place, is to give a few hints to guide those who have not hitherto conducted volumetric researches, in selecting collections of instruments, more or less complete, according to the course of operations which they intend to pursue.

The lists furnished with this view will be confined to instruments graduated according to the DECEM standard; but other collections of instruments, of similar extent, and at nearly the same prices, can be prepared to suit either the DECIM standard, or that of the CENTIMETRE CUBE.

The items in these collections can be limited or enlarged to any extent the purchaser wishes. The descriptions and figures of the instruments will be found at the numbers placed in the margin of these lists; and at the places referred to, other varieties, differing in size, form, or style of graduation, will be found of each instrument, from among which the chemist can select such as seem best to suit his purpose.

No notice is taken in these lists of instruments of common use, but which are not volumetric; such as balances, weights, mortars, boiling flasks, evaporating basins, gas bottles, lamps, gas burners, and the like; ample details respecting such instruments are given in other sections of this work.

In the article "Urinometry," examples are given of sets of volumetric apparatus suitable for a definite series of operations. See No. 4070.

396. VOLUMETRIC APPARATUS. SET A. Price £7.

- 388, 25. Pair of Mohr's Burettes, 55 Septems in $\frac{1}{2}$ s., 8s.
- 388, 30. Pair of Mohr's Burettes, 100 Septems in $\frac{1}{2}$ s., 9s.
- 388, 23. One Mohr's Burette, 35 Septems in $\frac{1}{2}$ s., 4s.
- 398 a. Mahogany Clamp Stand for a pair of Mohr's Burettes, 7s. 6d.
- 704. Metal Support for a pair of Mohr's Burettes, with three arms, 6s. 6d.
- 728. Erdmann's Floats for the 5 Burettes, 1s. 6d., *each*.
- 389, 13. Mohr's Burette, with Glass Stopcock. 35 Septems in $\frac{1}{2}$ s., 5s. 6d.
- 736, 25. Binks's Burette, 100 Septems in $\frac{1}{2}$ s., 4s. 6d.
- 738. Mahogany Foot for Binks's Burette, 1s. 6d.
- 768. Bulb Pipettes, 2 each of 5 and 10 Septems, *the set*, 2s. 6d.
- 768. Ditto, 1 each 15, 20, 25, 50, 100 Septems, *the set*, 5s. 5d.
- 768, 33. Ditto, for 1 fluid ounce, 1s.
- 768, 36. Ditto, for 1 cubic inch, 1s.
- 768, 41. Ditto, for 1 fluid drachm, 1s.
- 769, 25. Scale Pipettes, 1 Septem in $\frac{1}{2}$ s. 9d.
- 769, 30. Ditto, 10 Septems in $\frac{1}{2}$ s., 1s. 3d.
- 769, 33. Ditto, 20 Septems in $\frac{1}{2}$ s., 1s. 9d.
- 769, 28. Ditto, 5 Septems in $\frac{1}{2}$ s., 1s. 3d.
- 769, 40. Ditto, 50 Septems in $\frac{1}{2}$ s., 2s. 6d.
- 769, 42. Ditto, 100 Septems in $\frac{1}{2}$ s., 3s. 6d.
- 78. 2 Fluted Porcelain Rests for Pipettes, *each* 1s. 9d.
- 83. Measuring Flask, 1 each, for 50, 100, 200, 250, 500, and 1000 Septems, 8s.
- 83, 28. Ditto, 1 Imperial pint, 2s. 3d.
- 86, 1. Measuring Flask, with Stopper, for 1 Decigallon, 2s. 6d.
- 91, 1. Test Mixer, for 1 Decigallon, 6s.
- 91, 3. Ditto, for 5 Decigallons, 12s. 6d.

- 2798 a. Mixing Jars, 2 each, Nos. 1, 2, 3, 4, *the set*, 4s. 2d.
 2798 c. Ditto, 3 each, Nos. 8, 9, 10, *the set*, 8s. 3d.
 2799. Shaking Bottles, *three*, 2s.
 2800. White Glazed Porcelain Slab, *two*, 2s.
 2813. Griffin's Quick Filter, *two*, 6d.
 2814. Decanting Tube, *three*, 6d.
 2815, a. Porcelain Slab, for trying Colour Tests, 1s. 6d.
 2815, b. Ditto, with deeper cells, 1s.
 2817. Small Conical Test Glasses, for white precipitates, 1 *Dozen*, 1s. 6d.
 2818. Pipette Bottle, for Tincture of Litmus, 1s.
 2818. Ditto, for Tincture of Hematine, 1s.
 2431. Litmus Test Paper, 12 books in a bottle, 3s.
 1482. Set of 6 Beaked Tumblers, for Decanting Test Liquors, filling Burette &c. 4s.

2897. VOLUMETRIC APPARATUS. SET B. Price £3 10s.

- 2688, 30. Pair of Mohr's Burettes, 100 Septems in $\frac{1}{10}$ s., 9s.
 2688, 25. Mohr's Burette, 55 Septems in $\frac{1}{10}$ s., 4s.
 2688, 23. Mohr's Burette, 35 Septems in $\frac{1}{10}$ s., 4s.
 2689, 13. Mohr's Burette, with Glass Stopcock, 55 Septems in $\frac{1}{10}$ s., 5s. 6d.
 2698. Clamp Support for 2 Mohr's Burettes, Black Wood, 5s. 6d.
 2728. Erdmann's Floats, *two*, 3s.
 2768. Bulb Pipettes, 1 each, 5, 10, 25, 50, and 100 Septems, *the set*, 5s.
 2769, 25. Scale Pipette, 1 Septem in $\frac{1}{10}$ s., 9d.
 2769, 32. Ditto, 20 Septems in $\frac{1}{10}$ s., 1s. 6d.
 2769, 36. Ditto, 25 Septems in $\frac{1}{10}$ s., 2s.
 2769, 40. Ditto, 50 Septems in $\frac{1}{10}$ s., 2s. 6d.
 2778. Fluted Porcelain Rest for Pipettes, 1s. 9d.
 2783. Measuring Flasks, 1 each, 50, 100, 250, 500, and 1000 Septems, 6s. 9d.
 2791, 1. Test Mixer, for 1 Decigallon, 6s.
 2798 a. Mixing Jars, 1 each, Nos. 1, 2, 3, *the set*, 1s. 4d.
 2798 c. Ditto, 1 each, Nos. 8, 9, 10, *the set*, 2s. 9d.
 2799. Shaking Bottle, 8d.
 2800. White Glazed Porcelain Slab, 1s.
 2813. Griffin's Quick Filter, *two*, 6d.
 2814. Decanting Tubes, *three*, 6d.
 2815 a. Porcelain Slab, for trying Colour Tests, 1s. 6d.
 2817. Conical Test Glasses, *six*, 9d.
 2818. Pipette Bottle, for Litmus Tincture, 1s.
 1484. Set of 4 Beaked Tumblers, 2s. 4d.
 2426. Box of Test Papers, 1s.

2898. VOLUMETRIC APPARATUS. SET C. Price 42s.

- 2688, 30. Pair of Mohr's Burettes, 100 Septems in $\frac{1}{10}$ s., 9s.
 2688, 23. One Mohr's Burette, 35 Septems in $\frac{1}{10}$ s., 4s.
 2689, 13. One Mohr's Burette, with Glass Stopcock, 55 Septems in $\frac{1}{10}$ s., 5s. 6d.
 2697. Clamp Support for 1 Burette, Black Wood, 4s.
 2768. Bulb Pipettes, 10, 25, 50 Septems, *the set*, 3s.
 2769, 32. Scale Pipettes, 20 Septems in $\frac{1}{10}$ s., 1s. 6d.
 2769, 30. Ditto 10 " $\frac{1}{10}$ s., 1s. 3d.
 2783. Measuring Flasks, 50, 100, 500, 1000 Septems, *the set*, 5s. 6d.
 2798 a. Mixing Jars, 1 each, Nos. 1, 2, 3, 4, *the set*, 2s. 1d.
 2798 b. Ditto, 1 each, Nos. 5, 6, *the set*, 1s. 2d.
 2800. White Glazed Porcelain Slab, 1s.

2813. Griffin's Quick Filter, *two*, 6d.
 2814. Decanting Tubes, *three*, 6d.
 2815 *a*. Porcelain Slab, for trying Colour Tests, 1s. 6d.
 2817. Conical Test Glasses, *four*, 6d.
 2818. Pipette Bottle, for Litmus Tincture, 1s.
2899. VOLUMETRIC APPARATUS. SET D. Price 21s.
2688. Mohr's Burette, 100 Septems in $\frac{1}{4}$ s., 4s. 6d.
 2702. Metal Support for Mohr's Burette, 3s. 6d.
 2768. Bulb Pipettes, for 10 and 50 Septems, 2s.
 2769. Scale Pipettes, for 20 Septems in $\frac{1}{4}$ s., 1s. 6d.
 2783. Measuring Flasks for 100 and 1000 Septems, 3s.
 2798. Mixing Flasks, Nos. 2, 4, 9, 2s.
 2800. White Glazed Porcelain Slab, 1s.
 2813. Griffin's Quick Filter, *two*, 6d.
 2814. Decanting Tube, *three*, 6d.
 2815 *a*. Porcelain Slab, for trying Colour Tests, 1s. 6d.
 2818. Pipette Bottle, for Litmus Tincture, 1s.

Graduated Test Solutions for Volumetric Analysis.

2900. The following Test Solutions comprise such as are chiefly in demand at the present time; but as new processes, modifications of existing processes, and adaptations to manufacturing purposes, appear almost every month, it is clear that a list of this description must be subject to very frequent revision. From time to time, therefore, supplementary catalogues will be published.

The TEST SOLUTIONS are arranged in *three classes*, corresponding to the three units of measurement,—namely, the Septem, the Centimetre Cube, and the Decem.

The PRICES quoted in the following list are for the IMPERIAL PINT of 20 fluid ounces, and the HALF GALLON of 80 ounces. These prices include the cost of STOPPERED GLASS BOTTLES. If the pint Bottles are of fine German glass, and of the form of Fig. 1551, the extra charge for each is 9d.

VOLUMETRIC CHEMICAL SOLUTIONS, FOR USE WITH INSTRUMENTS GRADUATED INTO SEPTEMS.

2901. One equivalent of any chemical, weighed in grains and dissolved in a Decigallon of solution at 62° F., constitutes a solution of ONE DEGREE of strength, marked 1°. Every additional equivalent in grains included in this measure of solution, increases the strength by 1°: five equivalents in grains dissolved in a Decigallon, produce a solution of 5°; half an equivalent produces a solution of $\frac{1}{2}$ °; and so on. Since a Decigallon contains 1000 Septems, it is easy to value fractional parts of the dissolved chemical: thus, supposing the solution to be of 1° of strength,—

1000	Septems	contain	1	atom
100	"	"	·1	"
10	"	"	·01	"
1	Septem	contains	·001	"

The acting powers of the solutions necessarily correspond with their strength in equivalents, or degrees. Thus, 100 Septems of any alkaline solution of 1°, containing the $\frac{1}{1000}$ th part of an atom, will

neutralise the $\frac{1}{10}$ th part of an atom of any monobasic acid, and 1 Septem of such a solution will neutralise the $\frac{1}{1000}$ th part of an atom. Hence, the weight of a quantity of any acid submitted to analysis is found by multiplying the $\frac{1}{1000}$ th part of its atom in grains by the number of Septems of any alkali used to saturate it.

ACID TEST SOLUTIONS, for the estimation of **ALKALIES** and **ALKALINE EARTHS** when in the caustic state, or in the state of Carbonates. Nos. 2903 to 2914.

TEST ACIDS of ONE DEGREE (1°). The four TEST ACIDS, Nos. 2903 to 2906, are of the same strength. They each contain in a Decigallon one atom of ACID weighed in grains. One Septem of each contains the $\frac{1}{1000}$ th part of an atom, and is competent to neutralise the $\frac{1}{1000}$ th part of an atom in grains of any **ALKALI** or **ALKALINE CARBONATE** considered as monobasic.

2903. **SULPHURIC ACID** of 1° . HSO^2 . 49. Solution containing 49 grains in a Decigallon. 1 Septem = .049 grains of HSO^2 , or .04 grain of anhydrous acid. *Pint*, 2s.; *Half-gallon*, 6s.

2904. **NITRIC ACID** of 1° . HNO^3 . 63. Solution containing 63 grains in a Decigallon. 1 Septem = .063 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2905. **HYDROCHLORIC ACID** of 1° . HCl . 36.5. Solution containing 36.5 grains in a Decigallon. 1 Septem = .0365 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2906. **OXALIC ACID** of 1° . HCO^2 . 45. The crystallized acid is $\text{HCO}^2 + \text{Ac}$. 63. Solution containing 45 grains of HCO^2 or 63 grains of the crystallized acid in a Decigallon. 1 Septem = .045 grain of HCO^2 = .063 grain of $\text{HCO}^2 + \text{Ac}$ or .036 grain of $\frac{1}{2} \text{C}^2\text{O}^3$, the anhydrous acid. *Pint*, 2s.; *Half-gallon*, 6s.

TEST ACIDS of FIVE DEGREES (5°). The four acids, Nos. 2908 to 2911, are of equal strength. They each contain, in a Decigallon, five atoms of acid, weighed in grains; that is to say, they are five times as strong as the acids described above. 1 Septem of each contains the $\frac{5}{1000}$ th part or the $\frac{1}{200}$ th part of an atom of ACID, and it is competent to neutralise the $\frac{5}{1000}$ th or the $\frac{1}{200}$ th part of an atom, weighed in grains, of any **ALKALI** or **ALKALINE CARBONATE**, estimated as monobasic.

2908. **SULPHURIC ACID** of 5° . HSO^2 . 49×5 . Solution containing 245 grains in a Decigallon. 1 Septem = .245 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2909. **NITRIC ACID** of 5° . HNO^3 . 63×5 . Solution containing 315 grains in a Decigallon. 1 Septem = .315 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2910. **HYDROCHLORIC ACID** of 5° . HCl . 36.5×5 . Solution containing 182.5 grains in a Decigallon. 1 Septem = .1825 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2911. **OXALIC ACID** of 5° . HCO^2 . 45×5 . Solution containing 225 grains of HCO^2 , or 315 grains of crystals in a Decigallon. 1 Septem = .225 grain of HCO^2 , or .315 grain of crystallised acid. *Pint*, 2s.; *Half-gallon*, 6s.

2912. **SULPHURIC ACID** of 10° . HSO^2 . 49. Solution containing $49 \times 10 = 490$ grains of hydrated sulphuric acid, or 400 grains of anhydrous sulphuric acid in a Decigallon. *Pint*, 2s.; *Half-gallon*, 6s.

2912a. **USE OF THIS TEST LIQUOR.** 1 Septem contains 0.49 grain of HSO^2 , and neutralises:—

0.31 grain of	Anhydrous Soda.
0.40 "	Hydrate of Soda.
0.53 "	Anhydrous Carbonate of Soda.
0.47 "	Anhydrous Potash.
0.56 "	Hydrate of Potash.
0.69 "	Carbonate of Potash.
0.17 "	Ammonia.

Accordingly, if 40 grains of crude hydrate of soda are dissolved and tested with this acid, the number of Septems of acid used indicates the *percentage of pure substance* contained in the crude sample; and so on of the other salts.

2912*b*. ESTIMATION OF THE DIFFERENT CONSTITUENTS OF CRUDE CAUSTIC SODA.—The following is an example of a more intimate examination of caustic soda performed with one weighing and with dilute test solutions:—Weigh 40 grains of crude soda, and make with it a solution of 1000 Septems. Of this solution use 100 Septems for each testing process. 1. Neutralise with nitric acid of 1°, using Mohr's Burette. The Septems of acid used show the percentage of caustic soda in the sample. The same number, multiplied by .031 (see table 2913), shows the weight of anhydrous soda in $\frac{1}{10}$ = 4 grains of the crude soda. 2. Precipitate 100 Septems with a slight excess of chloride of barium, filter off the carbonate of barytes, and test the residual liquor with nitric acid of 1°. The number of Septems of acid used indicate the alkalinity due to hydrate of soda, not including that due to carbonate of soda. 3. Neutralise 100 Septems with nitric acid (example 1 shows how much is to be added), and precipitate sulphuric acid with nitrate of barium of 1° (Nos. 2935 and 2935*b*). 4. Neutralise 100 Septems with nitric acid, and precipitate chlorine by nitrate of silver of 1° (No. 2948). There yet remains 600 Septems of solution, with which, if required, other estimates can be made, such as those of sulphide, hyposulphite, silica, &c. In this analysis, experiments 1 and 2 can be made with graduated sulphuric or oxalic acid; but as nitric acid is indispensable for experiments 3 and 4, the use of that acid for experiments 1 and 2 also saves the time and trouble of cleaning and drying additional burettes.

2912*c*. INTERFERENCE OF CARBONIC ACID WITH THE COLOUR TESTS IN PROCESSES OF ALKALIMETRY.—When carbonates of the alkalies, or alkalies reputed to be caustic, but which commonly contain some carbonate, are tested with graduated acids, the liberated carbonic acid reddens the litmus before the alkali is quite saturated with the test acid. To remove this difficulty, the solution must be boiled, and the testing be completed while the liquor is boiling hot. When many samples have to be tested, the most rapid and effectual way of proceeding is to mount two burettes, one with test acid and another with test alkali of equal strength. Then to overdose the alkali with the test acid, boil thoroughly to get rid of the carbonic acid, and conclude by bringing back the mixture to the neutral point, by adding the test alkali. The Septems of test acid used, minus the Septems of test alkali, show the true degree of the alkali that is submitted to analysis.

All the crude salts of potash and soda, caustic and carbonated, can be tested by the above process.

2912*d*. Chemical manufacturers are much in the habit of using strong test solutions, such as No. 912; but I take the liberty to suggest, that if they study the use of the pipette, which I have described in sections 2760-2766, and conduct their testing in the manner shown above, they will find it preferable to work with dilute solutions, especially such as are here described as of 1° of strength.

913. ALKALIES and ALKALINE EARTHS ESTIMATED BY ACID TEST SOLUTIONS.

The Quantities are expressed in Grains.

		A. 1 Septem of Acid of 1° =	B. 1 Septem of Acid of 5° =
	Atomic Weight.		
Ammonia, NH^3	17	.017	.085
Ammonium, NH^4	18	.018	.09
Barium, Ba	68.5	.0685	.3425
„ Oxide, Barytes, BaBaO	153	.0765	.3825
„ Hydrate, BaHO	85.5	.0855	.4275
„ Carbonate, Ba^2CO^3	197	.0985	.4925
Calcium, Ca.	20	.020	.1
„ Oxide, anhydrous lime, CaCaO	56	.028	.14
„ Hydrate, CaHO	37	.037	.185
„ Carbonate, Ca^2CO^3	100	.050	.25
Potassium, K	39	.039	.195
„ Oxide, anhydrous potash, KKO	94	.047	.235
„ Hydrate, caustic potash, KHO	56	.056	.28
„ Carbonate, K^2CO^3	138	.069	.345
„ Bicarbonate, HKCO ³	100	.100	.5
Sodium, Na	23	.023	.115
„ Oxide, anhydrous soda, NaNaO	62	.031	.155
„ Hydrate, caustic soda, NaHO	40	.040	.2
„ Carbonate, Na^2CO^3	106	.053	.265
„ do. cryst., $\text{Na}^2\text{CO}^3 + \text{Aq.}^{10}$	286	.143	.715
„ Bicarbonate, HNaCO ³	84	.084	.42

2914. USE OF THE TABLE, No. 2913.—When any alkaline solution is submitted to volumetric analysis against an acid of 1° or 5° , the number of Septems of test acid used, multiplied by the number given in this table, is the weight in grains of the real alkali of the substance that was submitted to analysis, or of its equivalent in a corresponding salt.

Example.—If an arbitrary quantity of a solution of soda requires 20 Septems of acid of 1° (it is no consequence which of the four acids is used), then 20, if multiplied by $\cdot 031$, gives the corresponding weight of anhydrous soda; if multiplied by $\cdot 04$, it gives the weight of hydrated soda; if by $\cdot 053$, it gives the weight of carbonate of soda; and if by $\cdot 084$, it gives the weight of bicarbonate of soda; and so forth. It will be noticed that the anhydrous oxides and the carbonates are symbolised as Bibas while the hydrates and bicarbonates are Monobasic. This is necessarily the case when the atom of oxygen is held to weigh 16. The acids that saturate one monobasic atom, act only upon half an atom of a bibasic substance. In fixing upon quantities of alkalies or their carbonates to be submitted to trial, this difference must be attended to, as it has been in framing the table, No. 2913. 10 times the quantity of any substance named in column A, subjected to trial with an acid of 1° , will give *per cents.* of pure substance. Thus, 6.9 grains of carbonate of potassium and 10 grains of bicarbonate will, if pure, each neutralise 100 Septems of any acid of 1° ; but if they are impure, the percentage of impurity will be equal to the difference between 100 Septems of acid, and the number of Septems actually used in the trial.

The strongest possible alkaline solutions that can exist at 62° F. are these:—

Caustic Ammonia, 125° .
Caustic Potash, 101.7° .
Caustic Soda, 88.26° .

Carbonate of Potash, 83.54° .
Carbonate of Soda, 23.3° .
Both considered Monobasic.

Hence, for example, 1 Septem of Ammonia saturated at 62° F. requires 125 Septems of any acid of 1° to neutralise it, and the quantity of ammonia contained in it is $125 \times \cdot 017 = 2.125$ grains; whereas, 1 Septem of concentrated solution of carbonate of soda requires only $23\frac{1}{3}$ Septems of acid of 1° to saturate it.

ALKALINE TEST SOLUTIONS, for the estimation of FREE ACIDS. Nos. 2916 to 2932.

TEST ALKALIES of ONE DEGREE (1°). The five Test Alkalies, Nos. 2916 to 2921, are of the same chemical strength. They each contain in a Decigallon one atom of ALKALI weighed in grains. 1 Septem of each contains the $\frac{1}{1000}$ th part of an atom, and is competent to neutralise the $\frac{1}{1000}$ th part of an atom in grains of any monobasic Acid.

2916. POTASSIUM HYDRATE of 1° . Caustic Potash. KHO . 56. Solution containing 56 grains in a Decigallon. 1 Septem = $\cdot 056$ grain. *Pint*, 2s.; *Half-gallon*, 1s. 6d.
2917. SODIUM HYDRATE of 1° . Caustic Soda. NaHO . 40. Solution containing 40 grains in a Decigallon. 1 Septem = $\cdot 04$ grain. *Pint*, 2s.; *Half-gallon*, 1s. 6d.
2918. POTASSIUM CARBONATE of 1° . Carbonate of Potash. K^2CO^3 . 138. But used as monobasic. Atomic weight $\frac{132.8}{2} = 66.4$. Solution containing 66.4 grains in a Decigallon. 1 Septem = $\cdot 0664$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2919. SODIUM CARBONATE of 1° . Carbonate of Soda. Na^2CO^3 . 106. But used as monobasic. Atomic weight $\frac{106}{2} = 53$. Solution containing 53 grains in a Decigallon. 1 Septem = $\cdot 053$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2920. AMMONIA of 1° . NH^3 . 17. Solution containing 17 grains in a Decigallon. 1 Septem = $\cdot 017$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2921. COPPER AMMONIA-SULPHATE of 1° . Formula probably $\text{NH}^4\text{SO}^2 + \text{NH}^4\text{CuSO}_4$. 159.5. Solution containing 159.5 grains in a Decigallon. 1 Septem = $\cdot 1595$ grain. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2921a. This test is an azure blue solution, which, on being neutralised by an acid, loses its colour and gives a pale green precipitate. Its chief use is for testing acetic acid, the chemically neutral salts of which acid are not neutral in their action upon colour tests, and for determining the quantity of free sulphuric acid of the solutions in galvanic batteries, and other mixtures of acid and metallic salts, as it acts on free acids only, and not on acid combined with zinc, copper, or other metals. 1 Septem of it is equal to the $\frac{1}{1000}$ th part of an atom in grains of any acid. It is not quite permanent, and its degree requires to be occasionally checked against nitric acid of 1° .

TEST ALKALIES of FIVE DEGREES (5°). The six Alkalies, Nos. 2923 to 2928, are of the same strength. They each contain in a Decigallon five atoms of alkali weighed in grains; that is to say, they are five times as strong as the alkalies described above. 1 Septem of each contains the $\frac{5}{1000}$ th part, or the $\frac{1}{200}$ th part

an atom of ALKALI, and it is competent to neutralise the $\frac{1}{1000}$ th part, or the $\frac{1}{200}$ th part of an atom, weighed in grains, of any monobasic ACID.

2923. POTASSIUM HYDRATE of 5° . Caustic Potash. KHO . 56×5 . Solution containing 280 grains in a Decigallon. 1 Septem = $\cdot 28$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2924. SODIUM HYDRATE of 5° . Caustic Soda. NaHO . 40×5 . Solution containing 200 grains in a Decigallon. 1 Septem = $\cdot 2$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2925. POTASSIUM CARBONATE of 5° . Carbonate of Potash. K^2CO^3 . 138. But used as monobasic. Atomic weight $\frac{138}{2} = 69 \times 5$. Solution containing 345 grains in a Decigallon. 1 Septem = $\cdot 345$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2926. SODIUM CARBONATE of 5° . Carbonate of Soda. Na^2CO^3 . 106. But used as monobasic. Atomic weight $\frac{106}{2} = 53 \times 5$. Solution containing 265 grains in a Decigallon. 1 Septem = $\cdot 265$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2927. AMMONIA of 5° . NH^3 . 17×5 . Solution containing 85 grains in a Decigallon. 1 Septem = $\cdot 085$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2928. COPPER AMMONIA-SULPHATE of 5° . Five times as strong as No. 2921. 1 Septem of it neutralises $\frac{1}{1000}$ th atom or $\frac{1}{200}$ th atom of any acid. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.
2929. AMMONIA of $\frac{2}{3}^\circ$. NH^3 . $17 \times \frac{2}{3}$. Solution containing 11.33 grains of ammonia in a Decigallon. 1 Septem = $\cdot 0133$ grain. *Pint*, 2s.; *Half-gallon*, 6s.

This test solution is equal in strength to a solution of 50 grains of crystallised tartaric acid in a decigallon. It is a useful strength for testing the acidity of wines. See article on the Chemical testing of Wines.

2930. AMMONIA of 7° . NH^3 . 17×7 . Solution containing 119 grains in a Decigallon. 1 Septem = $\cdot 119$ grain. *Pint*, 2s.; *Half-gallon*, 6s.
2931. SODIUM HYDRATE of 7° . Caustic Soda. NaHO . 40×7 . Solution containing 280 grains in a Decigallon. 1 Septem = $\cdot 28$ grain. *Pint*, 2s.; *Half-gallon*, 6s.

2931a. *Testing of Vinegars*.—Alkaline solutions of 7° are equal in strength to the Excise proof negar, the commercial No. 24.

2932. ACIDS ESTIMATED BY ALKALINE TEST SOLUTIONS.

The Quantities are expressed in Grains.

	1 Septem of Alkali of $1^\circ =$	1 Septem of Alkali of $5^\circ =$
Sulphuric Acid, HSO^2 Atomic Weight 49	$\cdot 049$	$\cdot 245$
„ anhydrous, S^2O^3 . 80	$\cdot 04$	$\cdot 2$
Hydrochloric Acid, HCl . 36.5	$\cdot 0365$	$\cdot 1825$
Nitric Acid, HNO^3 . 63	$\cdot 063$	$\cdot 315$
„ anhydrous N^2O^5 . 108	$\cdot 054$	$\cdot 27$
Oxalic Acid, HCO^2 . 45	$\cdot 045$	$\cdot 225$
„ cryst., $\text{HCO}^2 + \text{Aq}$. 63	$\cdot 063$	$\cdot 315$
Acetic Acid, H , $\text{C}^2\text{H}^3\text{O}^2$. 60	$\cdot 06$	$\cdot 3$
„ anhydrous, C^2H^3 , $\text{C}^2\text{H}^3\text{O}^3$. 102	$\cdot 051$	$\cdot 255$
Tartaric Acid, cryst., H , $\text{C}^2\text{H}^2\text{O}^3$. 75	$\cdot 075$	$\cdot 375$
Carbonic Acid, CO^2 in $\text{Na}^2\text{CO}^3 = 44$	$\cdot 022$	$\cdot 11$

2932a. The strongest solutions of the chief acids that can exist at 62°F . have the following degrees:—

Sulphuric Acid, 263.7° .
Hydrochloric Acid, 94° .
Nitric Acid, 169° .

Acetic Acid, 123.5° .
Oxalic Acid, 11.88° .

1 Septem of concentrated sulphuric acid requires $263 \frac{7}{10}$ Septems of any alkali of 1° to neutralise and the quantity of hydrated acid it contains is $263.7 \times \cdot 049 = 12.922$ grains. This example shows that when a concentrated acid is to be tested, the first step in the operation is to dilute the

acid from 1 volume to 10 volumes; that is to say, 10 Septems to 100 Septems, or 100 Septems to 1000 Septems, measuring the acid with a bulb pipette, No. 2768, and diluting it with water in measuring flask, No. 2783. A portion of this dilute acid is then to be tested, and the result to be multiplied by ten. A step, even preliminary to this, may be taken with strong acids. Put Septems of water into a small mixing jar, and add 1 Septem of the acid to be tested. Mix and take 1 Septem of the mixture, and test it with the proper alkaline solution. The result in Septems multiplied by 10, gives a rough idea of the strength of the acid. The apparatus being already set up for the careful trial, this preliminary experiment can be performed in two minutes, and it saves much test liquor.

TEST SOLUTIONS containing BARIUM and LEAD, for the estimation of CARBONATE and SULPHATES. Nos. 2933 to 2937.

2933. BARIUM CHLORIDE of 1°. BaCl . 104. Solution containing 104 grains in a Decigallon. 1 Septem = $\cdot 104$ grain or $\frac{1}{1000}$ th atom. *Pint*, 2s.; *Half-gallon*, 6s.

2934. BARIUM CHLORIDE of 5°. BaCl . 104×5 . Solution containing 520 grains in a Decigallon. 1 Septem = $\cdot 52$ grain or $\frac{5}{1000}$ th atom, or $\frac{1}{200}$ th atom. *Pint*, 2s.; *Half-gallon*, 6s.

2935. BARIUM NITRATE of 1°. BaNO^3 . 130.5. Solution containing 130.5 grains in a Decigallon. 1 Septem = $\frac{1}{1000}$ th atom or $\cdot 1305$ grain. *Pint*, 2s.; *Half-gallon*, 6s.

2935 a. ESTIMATION OF CARBONATES.—*Process 1.* Suppose that you have carbonic acid in solution with excess of alkali, and that you wish to estimate the carbonic acid only. Precipitate the carbonic acid with excess of barytes solution, filter and wash the precipitate, and then dissolve it in a slight excess of nitric acid of 1°, using an even number of Septems of that acid. After complete solution estimate the excess of nitric acid by an alkaline solution of 1°. Suppose 40 Septems of nitric acid and 4 Septems of alkali to be used, the product is $40 - 4 = 36$. This number, multiplied by $\cdot 022$, gives the equivalent of carbonic acid contained in the solution submitted to examination.

Process 2. If you have a solution of caustic alkali and carbonated alkali, and you wish to estimate the quantity of alkali present in each condition, follow the process described in section 2912b, expts. 1 and 2. The quantity of carbonated alkali being thus found, that of the carbonic acid is to be calculated.

2935b. ESTIMATION OF SULPHATES.—The solution containing the sulphate is tested with a solution of nitrate or chloride of barium until it ceases to give a precipitate. The method of finding the neutral point has been treated of in sections 2811 to 2817. 1 Septem of barytic solution of 1° throws down $\cdot 04$ grain of anhydrous sulphuric acid.

2936. LEAD NITRATE of 1°. PbNO^3 . 165.5. Solution containing 165.5 grains in a Decigallon. 1 Septem contains 0.1655 grain of PbNO^3 and 0.1035 grain of Pb, and is equal to 0.049 grain of hydrated sulphuric acid = HSO^2 , or 0.040 grain of anhydrous sulphuric acid = $\frac{1}{2} \text{S}^2\text{O}^3$. *Pint*, 2s.; *Half-gallon*, 6s.

2937. POTASSIUM BICHROMATE of $\frac{1}{4}$ °. $2\text{KCrO}^2 + \text{Cr}^2\text{O}^3$. 295. Solution containing $\frac{295}{4} = 73.75$ grains in a Decigallon; being equal to the preceding solution of Lead Nitrate. 1 Septem contains 0.07375 grain of bichromate of potassium, and precipitates 0.1035 grain of lead. *Pint*, 2s.; *Half-gallon*, 6s.

2937a. ESTIMATION OF SULPHURIC ACID.—The solution of sulphate to be submitted to analysis must contain no chloride, phosphate, nor arseniate; nor any compound that renders sulphate of lead insoluble, such as urate and acetate of ammonia.

Process.—Take in a graduated jar a measured quantity of the solution of sulphate, —10, 20, or 50 Septems, according to its presumed strength. Add from a burette the nitrate of lead of 1°, No. 2936, until an excess is added, stopping at an even number on the scale of the burette. Shake the mixture thoroughly, and add water to it, until the liquid is brought to an even number of Septems according to the scale on the graduated jar. Allow it to settle completely. Pipette off an aliquot part of the mixture, say $\frac{1}{3}$, $\frac{1}{4}$, or $\frac{1}{5}$ th part of the whole. Add to this separated portion an excess of acetate of soda, and then precipitate the excess of lead by the bichromate of potassium of $\frac{1}{4}$ °, No. 2937, applied by another burette. The indicator is drops of nitrate of silver applied as explained in the note, No. 2941a.

Result.—The Septems of lead solution made use of, minus the Septems of bichromate used in counteraction, indicate so many times 0.040 grains of anhydrous sulphuric acid present in the subject of assay.—SCHWARZ.

2937b. ESTIMATION OF LEAD.—Lead can be estimated by the Test solutions now under consideration. The lead is to be dissolved in nitric acid, the solution to be carefully neutralised with carbonate of soda, and the clear solution is to be mixed with an excess of acetate of soda. This solution, for a given number of Septems of it, is then to be treated with the bichromate of potassium solution, as described above. 1 Septem of the Bichromate Test, No. 2937, precipitates 0.1035 grain of lead.—SCHWARZ, *Zeitschrift der Chemie*, 1863.

TEST SOLUTIONS containing LEAD and URANIUM, for the estimation of PHOSPHORIC ACID in alkaline and earthy Phosphates. Nos. 2938 to 2943.

2938. LEAD NITRATE of 3° . PbNO^3 . 165.5. Solution containing 496.5 grains in a Decigallon; being equal to a solution of phosphoric acid of 1° . 1 Septem contains 0.4965 grain of nitrate of lead, and = 0.071 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

2939. POTASSIUM BICHROMATE of $\frac{3}{4}^{\circ}$. $2\text{KCrO}^2 + \text{Cr}^2\text{O}^3$. 295. Solution containing 221.25 grains in a Decigallon, being equal to the foregoing solution of nitrate of lead. 1 Septem = 0.4965 grain of nitrate of lead. *Pint*, 2s.; *Half-gallon*, 6s.

2940. LEAD NITRATE, *Empirical*. PbNO^3 . 165.5. Solution containing 349.65 grains in a Decigallon, being equal to 50 grains of anhydrous phosphoric acid. 1 Septem contains 0.34965 grain of nitrate of lead, and = 0.05 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

2941. POTASSIUM BICHROMATE, *Empirical*, but equal to the preceding solution of nitrate of lead, No. 2940. It contains 155.81 grains in a Decigallon. 1 Septem = 0.34965 grain of nitrate of lead = 0.05 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

2941a. ESTIMATION OF PHOSPHORIC ACID.—The solutions Nos. 2940 and 2941 (or those, Nos. 2938, 2939) are used for the estimation of phosphoric acid. The method is applicable to alkaline phosphates, and earthy phosphates, when the latter are dissolved in the smallest quantity of nitric acid. The solutions are to be mixed with an excess of acetate of soda solution. To a measured quantity of the solutions to be tested, the lead solution is to be run from a burette *in excess*. Tribasic phosphate of lead is precipitated. It is then necessary to determine how much of the lead solution that has been run in, remains in excess. This is done by means of the solution of bichromate of potassium, which is also added from a burette. The indication of a sufficient addition of this test is afforded by means of drops of solution of nitrate of silver, used with the testing slab No. 2815. A drop of the mixture, first filtered with the tube No. 2813, and then added to the nitrate of silver, gives no precipitate as long as any lead remains in the solution; but as soon as the lead is all precipitated, and bichromate of potassium becomes residual, the drops of nitrate of silver show a red precipitate. The process is shortened by performing the precipitation with the lead solution in a graduated cylinder, diluting with water to an even quantity, and after allowing the precipitate to subside, pipetting off 25 Septems, or any aliquot part, of the supernatant solution for testing with the chromic solution.

Result (supposing the solutions Nos. 2940 and 2941 to be used).—The Septems of lead solution, *minus* the Septems of chromic solution, give so many times 0.05 grain of anhydrous phosphoric acid.—SCHWARZ and MOHR. This process is not so applicable to the estimation of phosphoric acid in Urine, as the method with Uranium. For details, see Schwarz and Mohr in Fresenius's *Zeitschrift*, 1863, pages 379 and 392.

2942. SODIUM PHOSPHATE, *Empirical*. $\text{HNa}^2\text{PO}^4 + \text{Aq}^{12}$. 358. (Anhydrous Phosphoric Acid = $\frac{1}{2}$ PPO⁵ = 71.) Solution containing 100.85 grains in a Decigallon. This solution contains 20 grains of anhydrous phosphoric acid. 1 Septem = 0.02 grain of the acid. *Pint*, 2s.; *Half-gallon*, 6s.

2943. URANIC NITRATE, *Empirical*. $\text{Ue}^3\text{NO}^4 + \text{Aq}^3$. 252. Solution containing 141.98 grains in a Decigallon, that quantity being equal to the above solution of phosphate of sodium. 1 Septem = 0.02 grain of anhydrous phosphoric acid. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2943a. Nos. 2942 and 2943 are used for the estimation of phosphoric acid. See Mohr's *Titrimethode*, page 390; Neubauer's *Analyse des Harns*, page 148; Sutton's *Volumetric Analysis*, page 61; and No. 4020 in the article *Urinometry* in this work. The Uranium test is found to be the most accurate for use in the examination of urine; but the cheaper lead test can be successfully used in the examination of alkaline and earthy phosphates.

TEST SOLUTIONS for the estimation of IODINE, BROMINE, and CHLORINE, and SULPHIDES, SULPHITES, HYPOSULPHITES, &c. Nos. 2944 and 2945.

2944. SODIUM HYPOSULPHITE of 2° . $\text{NaSO} + \text{HSO} + \text{Aq}^2$. 124. (Ordinary form $\text{NaO}, \text{S}^2\text{O}^2 + 5\text{HO} = 124$.) Solution containing 248 grains in a Decigallon. 1 Septem = $\cdot 248$ grain or $\frac{1}{1000}$ atom, being the equivalent of $\frac{1}{1000}$ atom or $\cdot 127$ grain of iodine. *Pint*, 2s.; *Half-gallon*, 6s.

2944a. *Use*.—For the estimation of iodine set free in a solution, and indirectly the estimation of chlorine. The latter is set free and distilled over into a solution of iodide of potassium, which sets iodine free. The distilling apparatus is described at Nos. 2359 to 2362. The solution containing the free iodine is mixed with a solution of starch, by which it is coloured blue. The sodium hyposulphite is then added till the blue colour disappears. See No. 2862a.

2945. IODINE of 1° . I. 127. Solution containing 127 grains of iodine dissolved in iodide of potassium in a Decigallon of solution. 1 Septem = $\cdot 127$ grain or $\frac{1}{1000}$ atom of iodine, that being equal to sodium hyposulphite of 2° . *Pint*, 3s.; *Half-gallon*, 10s.

2945a. *Use*.—To check the degree of the sodium hyposulphite, which is a little subject to change and to act as equivalent counter test to that solution, when it has been added in an overdose is also used to test sulphides, sulphites, and hyposulphites, arsenites, and the solutions of certain metals. See Mohr's *Titrimethode*, and other analytical works. The iodine solution must not be used with caoutchouc pinchcocks, nor come into contact with cork, paper, or other organic materials. Fig. 2826 represents a flask adapted to contain the iodine solution, and supply it to burettes conveniently.

2945b. ESTIMATION OF TIN, IN THE CHLORIDES OR MURIATES.—Dissolve the Chloride of Tin in a solution of one part of *tartarus natronatus* with eight parts of crystallised carbonate of soda. Mix a solution of tin in hydrochloric acid with this alkaline solution. As much of the latter as may be used as will in all cases make the tin solution clear. Dilute with water to a fixed volume. Take of this mixture 10 Septems; add to it some solution of starch, and then test with Iodine solution, No. 2945, till the liquor becomes blue. Multiply the Septems of Iodine used by $\cdot 059$. The product is the number of grains of tin contained in the 10 Septems of solution submitted to the test. See LEUSSEN, in MOHR'S *Titrimethode*, page 263.

TEST SOLUTIONS for the estimation of BLEACHING POWDER. Nos. 2946, 2947.

2946. SODIUM ARSENITE; namely, Arsenious Acid dissolved in an excess of Carbonate of Sodium. The acting ingredient is Arsenious Acid = As^2O^3 . 198. Strengthened solution of the solution $\frac{1}{4}^\circ$ or 49·5 grains in a Decigallon, that quantity produces a solution equivalent to the corresponding Iodine solution of 1° , No. 2945. 1 Septem = $\cdot 127$ grain of iodine, or $\cdot 0355$ grain of chlorine. *Pint*, 2s.; *Half-gallon*, 6s.

2947. SODIUM ARSENITE, *Empirical*. Solution containing 69·718 grains of Arsenious Acid dissolved in excess of Carbonate of Sodium in a Decigallon. This solution is equivalent to 50 grains of chlorine, so that 1 Septem indicates 0·05 grain of chlorine, or 100 Septems = 5 grains. *Pint*, 2s.; *Half-gallon*, 6s.

2947a. ESTIMATION OF CHLORINE IN BLEACHING POWDER.—Take 100 grains of bleaching powder, grind it in a flat mortar with a good spout, such as is represented by Fig. 2947a. It is finely ground, add water, mix it well, allow it to settle a little, and then decant the thin portion of the turbid liquor into a Decigallon Measuring Flask, No. 2783, 20. Add more water to the powder in the mortar, grind again, and decant as before. When the bleaching powder has thus by several affusions been all brought into the bottle, dilute the mixture to 1 Decigallon, shake it well, and measure off 100 Septems by a bulb pipette into a mixing jar for testing. Meanwhile fill a Mohr's burette with the arsenical test solution, No. 2947, and run the solution thence into the mixing jar. The indicator is a clear decoction of starch, with which a little iodide of potassium has been mixed. Drops of this indicator are upon the testing slab, No. 2815, and from time to time drops of the mixture of bleaching powder and arsenic are to be transferred by means of the decanting tube, No. 2814, into the cavities in the testing slab. At first, the indicator becomes greenish blue, and then blue, which abates in colour on succeeding drops of the mixture, until at last the drops of mixture produce no change in the indicator. The operation is then at an end.



2947a.

Result.—Observe how many Septems of the test liquor have been used. Multiply that number by 0.5, or divide it by 2: the product is the percentage of chlorine in the bleaching powder. Thus, if 60 Septems are used, the percentage of chlorine is 30.

TEST SOLUTIONS for the estimation of SILVER and of CHLORIDES, BROMIDES, IODIDES, and CYANIDES. Nos. 2948 to 2951.

2948. SILVER NITRATE of 1°. AgNO_3 . 170. Solution containing 170 grains in 1 Decigallon. 1 Septem = .17 grain, and precipitates the following quantities of chlorides, in grains:—

Chlorine	Cl .	=	.0355
Potassium Chloride	KCl .	=	.0745
Sodium Chloride	NaCl .	=	.0585
Ammonium Chloride	NH_4Cl .	=	.0535
Silver Chloride	AgCl .	=	.1435

Pint of this solution, 4s. 6d.; Half-gallon, 16s.

2949. SILVER NITRATE, *Empirical*, for the standard in Testing Photographic Baths. Solution containing 100 grains of silver nitrate in a Decigallon. 1 Septem = $\frac{1}{10}$ grain (= 0.1) of silver nitrate. *Pint, 3s. 6d.; Half-gallon, 12s.*

2950. SODIUM CHLORIDE of 1°. NaCl . 58.5. Solution containing 58.5 grains in 1 Decigallon. 1 Septem = .0585 grain, equal to 0.17 grain of nitrate of silver. *Pint, 2s.; Half-gallon, 6s.*

This solution is equal to Silver Nitrate, No. 2948.

2951. SODIUM CHLORIDE, *Empirical*, for testing Photographic Silver Baths. Solution containing 34.412 grains in 1 Decigallon. 1 Septem = .034412 grain of sodium chloride, equal to 0.1 grain of silver nitrate. *Pint, 2s.; Half-gallon, 6s.*

This solution is equal to Silver Nitrate, No. 2949.

2951a. ESTIMATION OF SILVER. *First Process.*—The solution of silver, measured with a pipette, put into a mixing bottle, such as No. 2799, and this is heated in a water bath, such as No. 1235. The chloride of sodium solution is then run into it from a Mohr's burette, until it ceases to give a precipitate. When the bottle is taken from the water bath to receive the salt test, it should be wiped with a cloth, and put into a cylinder of brown paper to shield it from the light. After giving the salt test, it is to be well shaken; upon which the chloride of silver conglomerates, leaving the liquor clear. A single drop of the salt test is then to be added. If no precipitate appear, the test is concluded. If a precipitate appear, more salt test is to be added, and the process continued till the silver is all precipitated.

2951b. *Second Process.*—The silver solution is made *very slightly* alkaline by the addition of a few drops of a solution of carbonate of soda. As much of the graduated solution of sodium chloride is then added as precipitates all the silver, and leaves a little of the salt test in excess. This is done by heating and shaking the mixture as in the first process, and then trying whether a drop of the salt test gives any more precipitate. The salt test is to be added to an even number of Septems. A few drops of a solution of yellow potassium chromate are then to be added to the mixture, and after that the solution of silver that corresponds to the salt test that has been used, namely, 2948 against 2950, or 2949 against 2951. When the extra salt of the salt test is all precipitated by the silver test, the first superfluous drop of the latter produces, with the indicating chromate, a *red precipitate*, which marks the conclusion of the operation. After abstraction of the Septems of silver test used in the second part of the process, the Septems of salt test indicate the amount of silver nitrate present in the subject of assay. Thus, every Septem of the salt solution, 2950, indicates 0.17 grain of silver nitrate, and every Septem of No. 2951 indicates 0.1 grain of silver nitrate. Namely, these numbers, multiplied by the number of Septems of salt test used, indicate the weight of silver nitrate contained in the quantity of silver solution measured off by a pipette for analysis.

2951c. EXAMINATION OF PHOTOGRAPHIC SILVER BATHS.—Silver Baths are commonly made with grains of nitrate of silver to the ounce, which is 480 grains to the Decigallon (of 16 ounces). A convenient solution for testing such baths is No. 2951, to be used alone, with process 1, No. 2951a, in combination with No. 2949, if the rapid second process, No. 2951b, is followed. Take 10 Septems of the solution of the silver bath, dilute it with 100 Septems of water, heat the mixture, give the salt test, and shake the bottle as above described, and repeat these operations till you have determined how many Septems of the salt solution, No. 2951, are required to saturate the 10

Septems of silver solution submitted to assay. That number, multiplied by 10, shows the grains in a Decigallon of silver nitrate contained in the silver bath submitted to analysis. If multiplied by 0·625, it shows the number of grains of silver nitrate contained in 1 fluid ounce of the solution. Thus, suppose the number of Septems of salt test required to precipitate 10 Septems of the silver bath to be 48, then :—

$$48 \times 10 = 480 \text{ grains of silver nitrate in the Decigallon, or 16 fluid ounces.}$$

$$48 \times \cdot 625 = 30 \text{ grains in 1 fluid ounce.}$$

2951d. *Testing the Purity of Nitrate of Silver.*—Weigh 5 grains of the salt, dissolve it in 10 Septems of water, and test it as above described with the salt solution, No. 2951. It should take 50 Septems. If it takes fewer Septems, twice the deficient number is the percentage of impurity. Thus, if 5 grains of the nitrate of silver are precipitated by 48 Septems of the salt test, then the impurity is twice 2 = 4 per cent.

2951e. *ESTIMATION OF CYANOGEN.*—Solution of silver nitrate is also used for the estimation of cyanogen and hydrocyanic acid. When a dilute solution of nitrate of silver is added to a solution of potassium cyanide, or of hydrocyanic acid first neutralised with potash, the silver combines with cyanogen, and the silver cyanide which is produced combines with potassium cyanide to form the double salt $\text{AgCy} + \text{KCy}$, which is soluble, so that no precipitate appears; but when all the potassium is thus combined, the first extra drop of nitrate of silver produces a precipitate. This indicates the point at which one atom of silver has acted on *two* atoms of cyanogen; and from the quantity of nitrate of silver used, that of the cyanogen present is calculated. Every Septem of silver nitrate of 1°, No. 2948, indicates ·052 grain of cyanogen, ·054 grain of hydrocyanic acid, and ·130 grain of cyanide of potassium.

TEST SOLUTIONS of BICHROMATE and PERMANGANATE of POTASSIUM, for the estimation of IRON, MANGANESE, TIN, and other metals. No. 2952 to 2958.

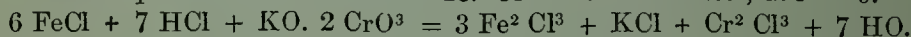
2952. POTASSIUM BICHROMATE. $2 \text{ KCr O}_2 + \text{Cr}_2\text{O}_3$. 295.

This salt converts Ferrous salts into Ferric salts. The indicator used is ferridecyanide of potassium, which gives a blue precipitate with the mixture as long as any ferrous salt is present. See Nos. 2810, 2815. The acting quantities in weight of Iron and Bichromate are as follow :—

EMPIRICAL QUANTITIES :—		SYSTEMATIC QUANTITIES :—	
Bichromate used.	Iron indicated.	Bichromate used.	Iron indicated.
·878	1 grain.	24·585	28 grains = 1 atom.
8·78	10 grains.	49·17	56 „ = 2 atoms.
43·9	50 „	147·5	168 „ = 6 atoms.
87·8	100 „	295·	336 „ = 12 atoms.

The following equations explain the reaction upon which analyses with this salt are founded :—

First Equation. $\text{O} = 8. \text{Fe} = 28. \text{Cr} = 26\cdot25. \text{Water, HO} = 9.$



Second Equation. $\text{O} = 16. \text{Fe} = 28. \text{Fec} = 18\cdot66. \text{Cr} = 26\cdot25. \text{Crc} = 17\cdot5. \text{Water, HHO} = 18$



It is evident from these equations, that for every 6 atoms of iron present, there must be added 7 atoms of free hydrochloric acid, to afford hydrogen to take up the oxygen of the chromate.

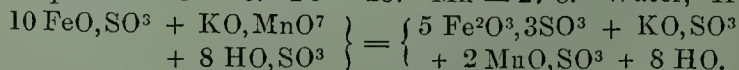
2953. POTASSIUM BICHROMATE of $\frac{1}{2}^\circ$. See No. 2952. Solution containing 147·5 grains in a Decigallon. 1 Septem indicates ·168 grain of iron. *Pint, 2s. Half-gallon, 6s.*

2954. POTASSIUM BICHROMATE *Empirical.* See No. 2952. Solution containing 87·8 grains in a Decigallon. 1 Septem indicates 0·1 grain of iron. *Pint, 2s. Half-gallon, 6s.*

2955. POTASSIUM PERMANGANATE. KMnc^3O_4 . 158.

This salt converts Ferrous salts into Ferric salts. The theory of the action is as follows :—

First Equation. $\text{O} = 8. \text{Fe} = 28. \text{Mn} = 27\cdot5. \text{Water, HO} = 9.$



Second Equation. $\text{O} = 16. \text{Fe} = 28. \text{Fec} = 18\cdot66. \text{Mn} = 27\cdot5. \text{Mnc} = 18\cdot33. \text{Water, HHO} = 18$

$$10 \text{ FeSO}^2 + \text{K Mnc}^3\text{O}_4 + 8 \text{ HSO}^2 = 15 \text{ FecSO}^2 + \text{KSO}^2 + 2 \text{ MnSO}^2 + 4 \text{ HHO.}$$

One equivalent of the Permanganate of Potash acts upon 10 equivalents of iron, or 158 parts of Permanganate upon 280 parts of iron. The 10 atoms of iron require the presence of 8 atoms of free

lphuric acid. Less than 8 atoms will not answer the purpose, and a great excess leads to errors. An apparatus for supplying sulphuric acid in these assays is described at No. 2866. Nitric acid and hydrochloric acid must be avoided. The acting quantities in grains are as follow :—

EMPIRICAL QUANTITIES :—		SYSTEMATIC QUANTITIES :—	
Permanganate used.	Iron indicated.	Permanganate used.	Iron indicated.
56·43	1 grain.	$15·8 = \frac{1}{10}$ atom.	28 grains = 1 atom.
2·8215	5 grains.	$31·6 = \frac{1}{5}$ „	56 „ = 2 atoms.
5·643	10 „	$158· = 1$ „	280 „ = 10 „
28·215	50 „		
56·43	100 „		

The phenomena exhibited by the action of the Permanganate of Potassium upon Ferrous salts is described at No. 2806. When ferric salts have to be tested, they must first be reduced to the condition of ferrous salts, or else they must be heated with a mixture of iodide of potassium and hydrochloric acid, which sets free iodine, and this free iodine must be tested with hyposulphite of sodium. According to Mohr, this is the most correct way of testing salts of iron, inasmuch as both the ferrous and ferric portions can be estimated in one solution. See Fresenius's *Zeitschrift für analytische Chemie*, 1863, page 243.

The Permanganate of Potassium, being subject to change its degree of strength, must be tested occasionally against pure ferric salts, or against oxalic acid; for which instructions are given by Mohr, Fresenius, &c.

2956. POTASSIUM PERMANGANATE of $\frac{1}{5}^{\circ}$. See No. 2955. Solution containing 31·6 grains of Permanganate of Potassium in a Decigallon. Equivalent to 56 grains or two atoms of iron. 1 Septem = ·056 grain of iron. 100 Septems = 5·6 grains of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2957. POTASSIUM PERMANGANATE, *Empirical*. Solution containing 56·43 grains in a Decigallon, equal to 100 grains of iron. 1 Septem = 0·1 grain of iron. 100 Septems = 10 grains of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2958. POTASSIUM PERMANGANATE, *Empirical*. Solution containing 28·215 grains in a Decigallon, equal to 50 grains of iron. 1 Septem = 0·05 grain of iron. 100 Septems = 5 grains of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

TEST SOLUTION for the estimation of LEAD and BARIUM. No. 2959.

2959. POTASSIUM SULPHATE of 1° . KSO^2 . 87. Solution containing 87 grains in a Decigallon. 1 Septem = ·087 grain, indicating ·1035 grain of lead. *Pint*, 2s.; *Half-gallon*, 6s.

2959a. *Estimation of Lead*.—This solution is used to precipitate lead from neutral solutions. The indicator is test paper prepared with a solution of iodide of potassium mixed with a little hyposulphite of sodium. This paper turns yellow when wetted with the mixture, until the lead is all precipitated. There must be no free nitric acid present. The process is not quite correct, as it shows 1 to $1\frac{1}{2}$ per cent. too little lead; but is useful for technical purposes.

2959b. A better method of estimating lead is described at No. 2937b.

2959c. *Estimation of Barium*.—The estimation of Barium by a Sulphate is the reverse of the estimation of a Sulphate by a salt of Barium, as described at No. 2935b. The factors showing the quantities of Barytic salts that are equivalent to 1 Septem of a Sulphate of 1° , are given in the table No. 2913.

2960. TINCTURE of LITMUS, in 3-ounce stoppered bottle, 1s.

2961. TINCTURE of HEMATINE, in 3-ounce stoppered bottle, 1s. 6d.

The Hematine tincture is useful in testing acidity in organic compounds, such as wine. In a dilute pure acid it has a lemon-yellow colour. When the acid is neutralised by dilute ammonia, the colour first turns brown, then a drop more of ammonia makes it pink, and larger quantities of ammonia make the colour crimson, violet, and blue. The brown colour seems to be the neutral point, and pink to indicate the presence of free acid. The colouring matter of wines interferes with the detection of this test, especially that of port wine. In testing such liquors, they must be greatly diluted. See article on the *Chemical Testing of Wines*.

VOLUMETRIC CHEMICAL SOLUTIONS FOR USE WITH INSTRUMENTS GRADUATED INTO CENTIMETRE CUBES.

2986. The solutions that are commonly called *NORMAL Solutions* contain one atomic weight of the active chemical, weighed in Grammes, and dissolved in a Litre of solution at 62° F.

DECINORMAL Solutions are of one-tenth part of that strength.

1 Centimetre Cube of any Normal solution contains the $\frac{1}{1000}$ th part of an atom of the dissolved chemical expressed in grammes. 1 Centimetre Cube of a Decinormal solution contains the $\frac{1}{10000}$ th part of an atom in grammes.

The choice of the quantity of substance to be chosen for analysis by means of these test liquors, is explained at No. 2683*b*.

NORMAL TEST ACIDS. The four solutions, Nos. 2988 to 2991, are of the same strength. They each contain in a Litre one atom of ACID weighed in grammes. 1 Centimetre Cube of each = $\frac{1}{1000}$ atom, and is competent to neutralise $\frac{1}{1000}$ atom in grammes of any monobasic ALKALI or ALKALINE CARBONATE.

2988. **SULPHURIC ACID.** HSO^2 , 49. Normal solution, containing 49 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom = .049 gramme of HSO^2 , or .04 gramme of S^2O^3 . *Pint*, 2*s.*; *Half-gallon*, 6*s.*

2989. **NITRIC ACID.** HNO^3 , 63. Normal solution, containing 63 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or .063 gramme of hydrated acid, or .054 of anhydrous acid. *Pint*, 2*s.*; *Half-gallon*, 6*s.*

2990. **HYDROCHLORIC ACID.** HCl , 36.5. Normal solution, containing 36.5 grammes in a Litre, 1 Centimetre Cube = $\frac{1}{1000}$ atom, or .0365 gramme. *Pint*, 2*s.*; *Half-gallon*, 6*s.*

2991. **OXALIC ACID.** HCO^2 , 45. The crystallized acid $\text{HCO}^2 + \text{Aq.}$, 63. Normal solution, containing 45 grammes of HCO^2 , or 63 grammes of the crystal in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or .045 gramme of HCO^2 . *Pint*, 2*s.*; *Half-gallon*, 6*s.*

NORMAL TEST ALKALIES. The four solutions, Nos. 2995 to 2998, are of the same strength. They each contain in a Litre one atom of ALKALI, weighed in grammes. 1 Centimetre Cube of each = $\frac{1}{1000}$ atom, and is competent to neutralize $\frac{1}{1000}$ atom in grammes of any monobasic ACID.

2995. **POTASSIUM CARBONATE.** Carbonate of Potash. K^2CO^3 , 138. Used as monobasic: $\frac{1}{2} (\text{K}^2\text{CO}^3) = 69$. Normal solution containing 69 grammes in a Litre. 1 CC = $\frac{1}{1000}$ atom, or .069 gramme. *Pint*, 2*s.*; *Half-gallon*, 6*s.*

2996. **POTASSIUM HYDRATE.** Caustic Potash. KHO , 56. Normal solution containing 56 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or .056 gramme. *Pint*, 2*s.*; *Half-gallon*, 6*s.*

2997. **SODIUM HYDRATE.** Caustic Soda. NaHO , 40. Normal solution containing 40 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or .04 gramme. *Pint*, 2*s.*; *Half-gallon*, 6*s.*

2998. **SODIUM CARBONATE.** Carbonate of Soda. Na^2CO^3 , 106. But used as monobasic, atomic weight $\frac{106}{2} = 53$. Normal solution containing 53 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom of a monobasic acid. *Pint*, 2*s.*; *Half-gallon*, 6*s.*

2999. **COPPER AMMONIA-SULPHATE.** $\text{NH}^4\text{SO}^2 + \text{NH}^4\text{CuO}$, 131.75. Normal solution containing 131.75 grammes in a Litre. But the solution is practically made equal to Normal Nitric Acid. 1 Centimetre Cube = $\frac{1}{1000}$ atom of any free acid. *Pint*, 2*s.* 6*d.*; *Half-gallon*, 7*s.* 6*d.*

MISCELLANEOUS TEST SOLUTIONS :

3003. BARIUM CHLORIDE. BaCl . 104. Normal solution, containing 104 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom or .104 gramme. *Pint*, 2s.; *Half-gallon*, 6s.
3004. SILVER NITRATE. AgNO_3 . 170. Decinormal solution, containing 17 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{10000}$ atom of chlorine = $\frac{2}{10000}$ atom of cyanogen. *Pint*, 3s. 6d.; *Half-gallon*, 12s.
3005. SODIUM CHLORIDE. NaCl . 58.5. Decinormal solution, containing 5.85 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{10000}$ atom of silver. *Pint*, 2s.; *Half-gallon*, 6s.
3008. SODIUM HYPOSULPHITE. $\text{NaSO} + \text{HSO} + \text{Aq}^2$ 124. [Usual formula, NaO , $\text{S}^2\text{O}_2 + 5 \text{HO} = 124$.] Solution $\frac{1}{10}$ normal, containing one-tenth of two atoms of the salt, $\frac{124}{5} = 24.8$ grammes in a Litre. 1 Centimetre Cube = $\frac{1}{10000}$ atom, or .0127 gramme of iodine. *Pint*, 2s.; *Half-gallon*, 6s.
3009. IODINE. I . 127. Decinormal solution, containing 12.7 grammes in a Litre, the iodine dissolved in iodide of potassium. 1 Centimetre Cube = $\frac{1}{10000}$ atom, or .0127 gramme of iodine. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.
3011. SODIUM ARSENITE. As_2O_3 . 198. Decinormal solution, containing 4.95 grammes of arsenious acid, with an excess of carbonate of soda, in a Litre. The solution is equivalent to the Decinormal solution of Iodine, No. 3009. 1 Centimetre Cube = $\frac{1}{10000}$ atom of chlorine, iodine, &c.; namely, = 0.00355 gramme of chlorine. *Pint*, 2s.; *Half-gallon*, 6s.
3014. POTASSIUM SULPHATE. KSO_2 . 87. Decinormal solution, containing 8.7 grammes in a Litre, used in the technical analysis of lead, to precipitate lead from neutral solutions. 1 Centimetre Cube = .01035 gramme of lead. *Pint*, 2s.; *Half-gallon*, 6s.
3015. POTASSIUM BICHROMATE. See No. 2952. Solution containing 4.917 grammes of the salt in a Litre. 1 Centimetre Cube = 0.0056 gramme of iron. *Pint*, 2s.; *Half-gallon*, 6s.
3016. POTASSIUM PERMANGANATE. See No. 2955. $\frac{1}{10}$ Normal, namely, containing $\frac{158}{10} = 15.8$ grammes of crystals in a Litre. This is equal to 5.6 grammes or $\frac{1}{1000}$ atom of iron. 1 Centimetre Cube = .0056 gramme of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.
3018. LEAD NITRATE. PbNO_3 . 165.6. $\frac{3}{10}$ solution, containing 49.65 grammes in a Litre. 1 Centimetre Cube = $\frac{3}{10000}$ atom, or 0.0071 gramme of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.
3019. POTASSIUM BICHROMATE. $2 \text{KCrO}_2 + \text{Cr}_2\text{O}_3$. 295. $\frac{3}{10}$ solution, containing 22.125 grammes in a Litre. This solution is equivalent to the Lead Nitrate $\frac{3}{10}$ solution, No. 3018. *Pint*, 2s.; *Half-gallon*, 6s.

The process of testing for Phosphoric Acid by means of the above solutions is explained at No. 2941a.

3021. SODIUM PHOSPHATE. $\text{HNa}_2\text{PO}_4 + \text{Aq}^{12}$. 358. [Anhydrous Phosphoric Acid = $\frac{1}{2} \text{PPO}_5 = 71$.] Solution containing 50.423 grammes in a Litre, including some acetate of sodium. This solution contains 10 grammes of anhydrous phosphoric acid. 1 Centimetre Cube = .01 gramme of that acid. *Pint*, 2s.; *Half-gallon*, 6s.
3022. URANIC NITRATE. $\text{Uc}_3\text{NO}_4 + \text{Aq}^3$. 252. Solution containing 71 grammes in a Litre, that quantity being equal to the above solution of phosphate of sodium. 1 Centimetre Cube = .01 gramme of anhydrous phosphoric acid. *Pint*, 5s. 6d.; *Half-gallon*, 18s.

VOLUMETRIC CHEMICAL SOLUTIONS, FOR USE WITH INSTRUMENTS GRADUATED INTO DECEMS.

3030. The solutions that are commonly called *NORMAL Solutions* contain ten times the atomic weight of the active chemical, weighed in grains, and dissolved in 1000 Decems of solution at 62° Fahr. *DECINORMAL Solutions* are of one-tenth part of that strength.

100 Decems of any normal solution contain an atom, weighed in grains, of the dissolved chemical.

One Decem contains the $\frac{1}{100}$ th part of an atom, and one Decem of a Decinormal solution contains the $\frac{1}{1000}$ th part of an atom, weighed in grains.

The choice of the quantity of substance to be taken for analysis by means of these test solutions, is explained at No. 2683b.

The solutions Nos. 3035, 3040, 3049, 3054, 3055, and 3061, are those prescribed for use in the British Pharmacopœia. See page 321 of this work.

NORMAL TEST ACIDS.—The four solutions Nos. 3032 to 3035 are of the same strength. They each contain ten atoms of Acid, weighed in grains, and dissolved in 1000 Decems of solution. 1 Decem of each contains the $\frac{1}{100}$ th of an atom. 100 Decems are competent to neutralize 1 atom in grains of any monobasic **ALKALI** or **ALKALINE CARBONATE**.

3032. **SULPHURIC ACID.** HSO^2 . 49. Normal solution, containing 490 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .49 grain. *Pint, 2s.; Half-gallon, 6s.*

3033. **NITRIC ACID.** HNO^3 . 63. Normal solution, containing 630 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .63 grain. *Pint, 2s.; Half-gallon, 6s.*

3034. **HYDROCHLORIC ACID.** HCl . 36.5. Normal solution, containing 365 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .365 grain. *Pint, 2s.; Half-gallon, 6s.*

3035. **OXALIC ACID.** HCO^2 . 45. Cryst. = $\text{HCO}^2 + \text{Aq}$. 63. Normal solution, containing 450 grains of HCO^2 , or 630 grains of crystals in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .45 grain of HCO^2 . *Pint, 2s.; Half-gallon, 6s.*

NORMAL TEST ALKALIES.—The four solutions Nos. 3038 to 3041 are of the same strength. They each contain in 1000 Decems ten atoms of **ALKALI**, weighed in grains. 1 Decem of each contains the $\frac{1}{100}$ th part of an atom. 100 Decems are competent to neutralize 1 atom in grains of any monobasic **ACID**.

3038. **POTASSIUM CARBONATE.** Carbonate of Potash. K^2CO^3 . 138. Used as monobasic. $\frac{1}{2}(\text{K}^2\text{CO}^3) = 69$. Normal solution, containing 690 grain in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .69 grain. *Pint, 2s.; Half-gallon, 6s.*

3039. **POTASSIUM HYDRATE.** Caustic Potash. KHO . 56. Normal solution, containing 560 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .56 grain. *Pint, 2s.; Half-gallon, 6s.*

3040. **SODIUM HYDRATE.** Caustic Soda. NaHO . 40. Normal solution, containing 400 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .4 grain. *Pint, 2s. Half-gallon, 6s.*

3041. **SODIUM CARBONATE.** Carbonate of Soda. Na^2CO^3 . 106. But used as monobasic. Atomic weight $\frac{1}{2} = 53$. Normal solution, containing 530 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or .53 grain. *Pint, 2s.; Half-gallon, 6s.*

3042. COPPER AMMONIO-SULPHATE. $\text{NH}_4\text{SO}_2 + \text{NH}_4\text{CuO}$. 131.75? Normal solution, containing 1317.5 grains in 1000 Decems. But the solution is made practically equal to normal nitric acid. 1 Decem = $\frac{1}{100}$ atom of any free acid. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.
3046. BARIUM CHLORIDE. BaCl . 104. Normal solution, containing 1040 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or 1.04 grain. *Pint*, 2s.; *Half-gallon*, 6s.
3049. SILVER NITRATE. AgNO_3 . 170. Decinormal solution, containing 170 grains in 1000 Decems. 1 Decem contains .17 grain, and = $\frac{1}{1000}$ atom of chlorine, = $\frac{2}{10000}$ atom of cyanogen. *Pint*, 3s. 6d.; *Half-gallon*, 12s. 6d.
3050. SODIUM CHLORIDE. NaCl . 58.5. Decinormal solution, containing 58.5 grains in 1000 Decems. 1 Decem = $\frac{1}{1000}$ atom of silver. *Pint*, 2s.; *Half-gallon*, 6s.
3054. SODIUM HYPOSULPHITE. $\text{NaSO} + \text{HSO} + \text{Aq}^2$. 124. [Usual formula $\text{NaO}, \text{S}^2\text{O}_2 + 5 \text{HO} = 124$.] Solution $\frac{1}{10}$ normal, containing one-tenth of 20 atoms of the salt, $\frac{124}{10} = 12.4$ grains, in 1000 Decems. 1 Decem = $\frac{1}{1000}$ atom, or .127 grain of iodine. *Pint*, 2s.; *Half-gallon*, 6s.
3055. IODINE. I . 127. Decinormal solution, containing 127 grains in 1000 Decems, the iodine dissolved in iodide of potassium. 1 Decem = $\frac{1}{1000}$ atom or .127 grain of iodine. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.
3057. SODIUM ARSENITE. As^2O_3 . 198. Decinormal solution, containing 49.5 grains of arsenious acid, with excess of carbonate of sodium, in a solution of 1000 Decems. 1 Decem = .127 grain of iodine, or .0355 grain of chlorine. *Pint*, 2s.; *Half-gallon*, 6s.
3060. POTASSIUM BICHROMATE. See No. 2952. Solution containing 49.167 grains in 1000 Decems. 1 Decem contains .04917 grain of bichromate, and indicates .056 grain of iron. *Pint*, 2s.; *Half-gallon*, 6s.
3061. POTASSIUM BICHROMATE. Solution containing 147.5 grains in 1000 Decems. 1 Decem contains .1475 grain, and indicates .168 grain of iron. *British Pharmacopæia*. *Pint*, 2s.; *Half-gallon*, 6s.
3062. POTASSIUM BICHROMATE. Solution containing 87.8 grains in 1000 Decems. 1 Decem indicates 0.1 grain of iron. *Percy*. *Pint*, 2s.; *Half-gallon*, 6s.
3065. POTASSIUM PERMANGANATE. See No. 2955. $\frac{1}{10}$ Normal, containing $\frac{156.8}{10} = 15.68$ grains of crystals in 1000 Decems. This is equal to 56 grains of iron. 1 Decem = .056 grain of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.
3066. POTASSIUM PERMANGANATE. See No. 2955. Empirical solution, containing 56.43 grains in 1000 Decems, equal to 100 grains of iron. 1 Decem = .1 grain of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.
3070. LEAD NITRATE. PbNO_3 . 165.5. $\frac{1}{10}$ solution, containing 496.5 grains in 1000 Decems. 1 Decem = .071 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.
3071. POTASSIUM BICHROMATE. $2 \text{KCrO}_2 + \text{Cr}_2\text{O}_3$. 295. $\frac{3}{10}$ solution, containing 221.25 grains in 1000 Decems, being equal to the foregoing solution of nitrate of lead. 1 Decem = .4965 grain of nitrate of lead. *Pint*, 2s.; *Half-gallon*, 6s.
3072. SODIUM PHOSPHATE. $\text{HNa}^2\text{PO}_4 + \text{Aq}^{12}$. 358. [Anhydrous phosphoric acid = $\frac{1}{2} \text{PPO}_5 = 71$.] Solution of 504.23 grains in 1000 Decems. This solution contains 100 grains of anhydrous phosphoric acid. 1 Decem = 0.1 grain. *Pint*, 2s.; *Half-gallon*, 6s.
3073. URANIUM NITRATE. $\text{Ur}^2\text{NO}_4 + \text{Aq}^3$. 252. Solution containing 710 grains in 1000 Decems, that quantity being equal to the above solution of phosphate of sodium. 1 Decem = 0.1 grain of anhydrous phosphoric acid. *Pint*, 5s. 6d.; *Half-gallon*, 18s.

ANY TEST SOLUTIONS DIFFERING FROM THOSE CONTAINED IN THE PRECEDING LISTS CAN BE PREPARED TO ORDER.

URINOMETRY.

GRADUATED TEST SOLUTIONS and APPARATUS for the VOLUMETRIC ANALYSIS OF URINE, according to the method of NEUBAUER and VOGEL, as described in their "*Anleitung zur qualitativen und quantitativen Analyse des Harns*," Fourth Edition, 1863, an English translation of which work has been published by THE SYDENHAM SOCIETY.

The Test Solutions belonging to this set are all made on the LITRE standard, in order that they may agree with the instructions given in the above-named work, and the measurements of small quantities are all directed to be made in CENTIMETRIC CUBES, marked CC.

Only such Test Liquors have been prepared for sale as are in current request. If the work above referred to other kinds are mentioned, which can be supplied if desired, as can also the pure chemicals and apparatus required for effecting analyses of urine by gravimetric methods.

4000. ESTIMATION OF CHLORIDE OF SODIUM.

The estimation of Chloride of Sodium in urine requires the Barytic solution, No. 4004; the Mercuric Nitrate solution, No. 4005; the Sodium Chloride solution, No. 4006; the Urea solution, No. 4007 and the Sodium Sulphate solution, No. 4008.

4001. *Process*.—Mix 40 CC. of Urine with 20 CC. of the barytic solution. Shake the mixture well and filter it through a dry filter. Measure off 15 CC. of the clear liquor into a mixing jar. See No. 2798. If it is alkaline to test paper, it must be neutralized with nitric acid, so as to have the slightest possible excess of that acid. If the filtered solution is found to be acid, before adding the nitric acid, the quantity of barytes added to the urine was, perhaps, too little. To test this, add to a little of the filtered non-acidified liquor, a few drops of the barytic solution. If this produces a precipitate, you must begin afresh:—Mix 20 CC. of urine with 20 CC. of the barytic liquor, and measure off 20 CC. of the filtered mixture for analysis. The 15 CC. of the mixture contain 10 CC. of urine separated from sulphates and phosphates. To this mixture, the mercuric solution is to be run gradually from a Mohr's burette, until, after well stirring and shaking the mixture in the jar, there appears a permanent precipitate. This precipitate is produced by the action of the mercury on the urea in the urine, after the action of the salt on the mercury is concluded. The operation is then finished. The number of CC. of mercuric solution used, as shown by the scale on the burette, indicate so many times 10 milligrammes (0.010) of chloride of sodium contained in 10 CC. of the urine.

4002. *Comparative Analyses*.—It is in all cases desirable to check the result of the Volumetric analysis of a mixed organic liquid, by a comparative experiment made with a pure solution of known strength of the chemical substance, the quantity of which it is attempted to estimate by the volumetric process. For this reason, I shall in this section cite the test liquors and processes that are suitable for performing comparative volumetric analyses of the chemical substances that are chiefly interesting in the practice of Urinometry. I will describe these as experiments of *Control*.

4003. *Control of the Estimation of Sodium Chloride in Urine*.—This consists in a repetition of the volumetric process upon a pure solution of Sodium Chloride. The solutions required are the Sodium Chloride, No. 4006; the Urea solution, No. 4007; the Sodium Sulphate solution, No. 4008. Take in a mixing jar 10 CC. of the normal solution of Chloride of Sodium, No. 4006; 3 CC. of the Urea solution, No. 4007; and 5 CC. of the Sodium Sulphate solution, No. 4008. Then add from Mohr's Burette, the Mercuric Nitrate solution, No. 4005, under continual agitation of the mixture until a permanent precipitate is produced, as described in No. 4001. This precipitate is caused by the Urea, but it is not produced until all the Sodium Chloride has acted, as far as it can, on the Mercuric solution. The Sodium Sulphate is used to prevent the disappearance of the compound Urea and Mercury when first precipitated from the mixture, which is, without that addition, liable to occur from the presence of the Nitric Acid that is set free by the decomposition of the Mercuric Nitrate.—The 10 CC. of Sodium Chloride solution, containing 0.200 of that salt, must take 20 CC. of the Mercuric Nitrate solution, No. 4005, before a precipitate of Urea occurs in the mixture.

4004. BARYTIC SOLUTION for PRECIPITATING PHOSPHATES and SULPHATES from URINE composed of one volume of saturated solution of Nitrate of Barium, and two volumes of saturated Barytic Water. See No. 4001. *Pint bottle, 2s. Half-gallon bottle, 6s.*

05. MERCURIC NITRATE Solution for estimating CHLORIDE of SODIUM in Urine. It contains 17·06 grammes of Mercury in a Litre. 1 CC. is = 10 milligrammes (0·010) of Chloride of Sodium. *Pint, 3s.; Half-gallon, 10s.*
06. SODIUM CHLORIDE. Normal solution, containing 20 grammes in 1 Litre. 10 CC. = 200 milligrammes (0·200). 1 CC. = 20 milligrammes (0·020) of Sodium Chloride. Used as a standard to regulate the analysis of Chlorides by the Mercuric Nitrate solution, No. 4005. *Pint, 2s.; Half-gallon, 6s.*
07. UREA. Solution to be prepared when required. It must contain 4 grammes in 100 CC. 1 CC. = 40 milligrammes (0·040) of Urea. *Bottle with 1 oz. pure Urea, 6s. 6d.*
08. SODIUM SULPHATE. Saturated solution. Used in the analysis of Sodium Chloride by Mercuric Nitrate. See No. 4003. *Pint, 2s.; Half-gallon, 6s.*
09. ESTIMATION OF UREA.

The estimation of Urea requires the Barytic solution, No. 4004; the Mercuric Nitrate solution, No. 4012; a saturated solution of Sodium Carbonate, No. 4013; and a solution of Urea, No. 4014.

010. *Process.*—Mix 40 CC. of Urine with 20 CC. of the Barytic solution, shake the mixture roughly, filter it through a dry filter, measure off 15 CC. into a mixing jar; but do not, as directed in No. 4001, neutralize it with nitric acid. On the contrary, if the solution is found to be alkaline to test paper, it must have a few drops of Carbonate of Soda added, to render it alkaline. To the mixture in the jar, which contains 10 CC. of urine, run in slowly the Mercuric Nitrate solution, No. 4012; stirring the mixture continually until the precipitation seems no longer to be produced by additional test liquor. The indication of the completion of the process is afforded by the Sodium Carbonate, No. 4013. Drops of the mixture of Urine and Mercuric solution are brought upon the testing slab, No. 2815, and drops of the Sodium solution are added to them. If the mixture remains white, the urine requires more of the Mercuric solution to be added to it. When the mixture on the slab becomes distinctly yellow, the process is completed. The quantity of Urea is calculated from the number of CC. of the Mercuric solution required to precipitate it. 1 CC. = 10 milligrammes (= 0·010) of Urea. But a correction is required for the quantity of the Mercuric test liquor employed by the Sodium Chloride present in the urine before the test liquor begins to act upon the urine. LIEBIG recommends the deduction of 2 CC. from the quantity of test liquor used as an average compensation. Professor HARLEY (*Medical Times*, April 30th, 1864, page 475) prefers to add to the red urine a few drops of Nitrate of Silver, to precipitate the chloride before the Mercuric solution is applied. MOHR directs us to add *exactly* as much Nitrate of Silver of known strength as serves to precipitate all the Chloride of Sodium that has been estimated by the process No. 4001. The results of experiment and calculation show the quantity of urea contained in 10 CC. of the analysed urine. That quantity, multiplied by 100, gives the weight of Urea in a Litre.

011. *Control.*—Take in a mixing jar 10 CC. of the Urea solution, No. 4014; which quantity contains 200 milligrammes of Urea. Test it with the Mercuric Nitrate solution, No. 4012. At first add about 18 CC. of the test liquor; then add it in small quantities of $\frac{1}{2}$ or $\frac{1}{4}$ CC., shaking the mixture thoroughly, and testing it with Carbonate of Soda, as directed in No. 4010. These solutions are so graduated, that 20 CC. of the Mercuric solution, No. 4012, are equal to 10 CC. of the Urea solution, No. 4014.

1. MERCURIC NITRATE Solution for estimating UREA in Urine. It contains 71·48 grammes of Mercury, or 77·2 grammes of Mercuric Oxide, in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Urea. 20 CC. = 200 milligrammes of Urea. *Pint, 3s. 6d.; Half-gallon, 12s.*
2. SODIUM CARBONATE. Saturated solution. Used as indicator of an excess of Mercuric Nitrate, as explained in No. 4010. *Pint, 2s.; Half-gallon, 6s.*
3. UREA. Solution containing 4 grammes of pure Urea, dried at 100° C. in 200 CC. 10 CC. of this solution = 200 milligrammes (0·200) of Urea. To be prepared when required. *Price, see No. 4007.*
4. ESTIMATION OF PHOSPHORIC ACID.

The most accurate and the most easily-executed process for estimating Phosphoric Acid in urine is by means of Nitrate of Uranium. It requires the following solutions:—Uranic Nitrate, No. 4023; Uranium Super-acetate, No. 4024; Potassium Ferrocyanide, No. 4025; and Sodium Phosphate, No. 4026.

4021. *Process*.—Put into a mixing jar, having a thin bottom to admit of boiling, 50 CC. of filtered urine. Add to it 5 CC. of the Sodium Super-acetate solution, No. 4024. It is important to take the liquors in these proportions. Heat the mixture in a water-bath to about 200° Fahr. (90 to 100° C.) and add the Uranic Nitrate solution, No. 4023, from a Mohr's Burette that is graduated into 10ths of CC. When the precipitate ceases to increase in quantity, which can be pretty easily perceived if the action of each new drop of the test liquor is watched on the edge of the solution, then stop time to apply the Indicator. To this end drops of the mixture, without filtration, are transferred to the cells of the porcelain slab, No. 2815; and are there tested with small drops of the solution of Potassium Ferrocyanide, No. 4025. The colour of the Indicator is pale yellow; but if an excess of the Uranic solution is present in the mixture, it imparts to the indicator a reddish-brown colour. Every CC. of Uranic test liquor made use of, indicates 5 milligrammes of Phosphoric Acid in the 50 CC. of Urine.

4022. *Control*.—Take in a mixing jar 50 CC. of the Sodium Phosphate solution, No. 4026, which is = 100 milligrammes of Phosphoric Acid; add 5 CC. of the Sodium Super-acetate solution, and heat the mixture in a water-bath to about 200° Fahr. Then add the Uranic Nitrate solution from Mohr's Burette graduated into 10ths of CC. At first add 18 CC. of the test, then proceed with ½ CC. at a time, and test with Potassium Ferrocyanide on the porcelain slab. The reddish-brown colour should appear on the slab, when 20 CC. of the Uranic test liquor have been added to 50 CC. of the Sodium Phosphate.

4023. URANIC NITRATE Solution, for the estimation of ANHYDROUS PHOSPHORIC ACID in Urine. It contains 20·3 grammes of Uranic Oxide (= 35·495 grammes of crystallized Uranic Nitrate) in a Litre. 1 CC. is = 5 milligrammes (0·005) of Anhydrous Phosphoric Acid. 20 CC. = 0·100 gramme of Phosphoric Acid. *Pint*, 3s. 6d.; *Half-gallon*, 12s.

4024. SODIUM SUPER-ACETATE, consisting of Acetate of Soda and free Acetic Acid. Solution to be added to Urine, in the proportion of 5 CC. to 50 CC. of Urine, to insure the precipitation of Uranic phosphate of constant composition. *Pint*, 2s.; *Half-gallon*, 6s.

4025. POTASSIUM FERROCYANIDE. Indicator of the completion of the precipitation of Phosphoric Acid by Uranic Nitrate. The solution should be weak and newly made, and be used with the porcelain slab, No. 2815. It is best to keep the salt in crystals, and to make an extemporaneous solution when it is required, in one of the cells of the testing slab, No. 2815. *Bottle* containing 2 oz. of pure crystals, 1s. 6d.

4026. SODIUM PHOSPHATE. Solution containing 10·085 grammes of the crystallized salt, equal to 2 grammes of Anhydrous Phosphoric Acid, in 1 Litre. 1 CC. = 2 milligrammes (0·002), and 50 CC. = 100 milligrammes (0·100) of Anhydrous Phosphoric Acid. Used as a standard to regulate the analysis of phosphates by the Uranic solution, No. 4023. 50 CC. of this Sodium Phosphate solution are equal to 20 CC. of Uranic Nitrate solution, No. 4023. *Pint*, 2s.; *Half-gallon*, 6s.

4031. ESTIMATION OF SULPHURIC ACID.

The estimation of Sulphuric Acid in Urine requires the Barium Chloride solution, No. 4034, and the Potassium Sulphate solution, No. 4035.

4032. *Process*.—Take a mixing jar with a narrow neck and a thin bottom that will bear boiling, such as No. 2798, *a* or *c*. Put into it 100 CC. of Urine, and 20 or 30 drops of Hydrochloric Acid, the latter in order to keep the solution acid during the succeeding operation, and thus prevent precipitation of phosphates. Boil the mixture, and then add the Barium Chloride solution, No. 4034, until the Sulphuric Acid is all precipitated. The Indication of the completion of the assay is given when the Barytic solution ceases to give any precipitate with the mixture. The method of making the exact precipitation of sulphates by barytic salts, has been described in detail in Nos. 2816 to 2817, and need not be repeated. A second operation should always be performed, in which 100 CC. of urine, mixed with 20 or 30 drops of Hydrochloric Acid, the greater part of the Barytic liquor shown by the first operation to be required is added at once, the mixture well shaken and boiled; and the rest of the test liquor then added in drops under frequent filtration and testing. Every CC. of the Barytic test solution used indicates 10 milligrammes of Anhydrous Sulphuric Acid present in 100 CC. of the Urine submitted to trial.

033. *Control*.—Boil in a similar mixing jar, a mixture of 100 CC. of water, and 20 CC. of the Potassium Sulphate solution, No. 4035. Test as above with the Barytic solution, No. 4034. As these solutions are made equivalent, 20 CC. of the one should exactly precipitate 20 CC. of the other.

34. **BARIUM CHLORIDE**. Solution containing 30·5 grammes of crystallized Barium Chloride in a Litre. 1 CC. is = 10 milligrammes (0·010) of Anhydrous Sulphuric Acid. *Pint*, 2s.; *Half-gallon*, 6s.

35. **POTASSIUM SULPHATE**. Solution containing 21·778 grammes of Potassium Sulphate in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Anhydrous Sulphuric Acid. *Pint*, 2s.; *Half-gallon*, 6s.

36. ESTIMATION OF FREE ACID.

The acid reaction of Urine may be due to the presence of Acid Phosphate of Soda, free Lactic Acid, or other organic acids. It is commonly estimated by comparison with crystallized Oxalic Acid. The titrimetric testing of free Acid in Urine requires the Sodium Hydrate solution, No. 4039; the Oxalic Acid solution, No. 4040; and Litmus test paper, No. 2423.

037. *Process*.—Take in a mixing jar 100 CC. of Urine; add to it from a narrow burette graduated to show 10ths of CC., the Soda solution, No. 4039, in very small quantities; even at first, not above 1 CC. at once, and speedily reducing that quantity to single drops. Shake the mixture after each addition of test liquor, and test the neutrality of the mixture by applying it with a glass stirrer to a piece of blue, red, or neutral litmus test paper. At last the mixture becomes neutral, and will not turn the blue litmus red, nor the red litmus blue. Every CC. of Soda solution, used to effect this result, indicates 10 milligrammes of crystallized Oxalic Acid in 100 CC. of the Urine submitted to test, or as much free acid of some sort as is equivalent to that quantity of oxalic acid.

In a case like this, where a *degree of acidity* is to be estimated and described, without particularizing the chemical body which causes the acidity, it is convenient to use the method of describing acidity in degrees, as explained at No. 2901. Thus, ACIDITY OF 1° would indicate the presence of one atom weighed in grains of any acid, or mixture of acids, contained in a Decigallon of the liquid examined.

038. *Control*.—The alkaline solution, No. 4039, and the acid solution, No. 4040, being of equal strength in equal measures, serve to check one another.

39. **SODIUM HYDRATE**. *Caustic Soda*. Solution containing 6·35 grammes of Caustic Soda in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of crystallized Oxalic Acid. 10 CC. = 0·100 gramme of Acid. *Pint*, 2s.; *Half-gallon*, 6s.

40. **OXALIC ACID**. Solution containing 10 grammes of crystallized Acid in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Acid. 10 CC. = 0·100 gramme of Acid. *Pint*, 2s.; *Half-gallon*, 6s.

2. ESTIMATION OF LIME.

The method of estimating the Lime contained in Urine is based on these facts. If oxalate of ammonia is added to a solution of phosphate of lime in acetic acid, the lime is all precipitated as oxalate of lime. If oxalate of lime is ignited, it is converted into a mixture of quicklime and carbonate of lime. This mixture can be dissolved in a measured quantity of graduated hydrochloric acid; and the excess of hydrochloric acid being estimated by a graduated solution of caustic soda, the difference shows the quantity of hydrochloric acid neutralized by the lime, and from this the weight of the lime can be calculated. This method of testing earthy carbonates has been described at No. 2935a.

043. *Process*.—Put 100 CC. of filtered Urine into a mixing jar; add to it caustic ammonia as long as it produces a precipitate; next, add acetic acid to redissolve this precipitate; but do this cautiously as not to give in excess more than a few drops of acetic acid. To this mixture add oxalate of ammonia, till it ceases to give a precipitate. Cover the mixing jar, and set it in a warm place for 6 or 8 hours, or until the precipitate has entirely subsided and the liquor become clear. Decant the liquor with a syphon, or a large pipette; bring the precipitate on a small filter, and wash it with hot water. Add the wash water to the decanted liquor, and set this mixture apart for the estimation of the magnesia present in it, when that estimation is desired. Put the washed precipitate, with the filter, into a small platinum crucible, dry it, and ignite it until the paper is burnt grey. Put the calcined lime into a small mixing jar; dissolve it in 10 CC. of the Hydrochloric Acid, No. 4044; boil it to drive off the carbonic acid, add a few drops of litmus solution, and neutralize the excess of acid with the Sodium Hydrate solution, No. 4045.

Result.—Deduct the CC. of Soda test from the 10 CC. of Acid test made use of. The remaining CC. of Acid test each indicate 10 milligrammes of lime, as contained in the 100 CC. of urine submitted to analysis. If the lime is to be estimated as milligrammes of phosphate of lime = PO_4 (or $3 \text{ CaO}, \text{PO}_4$), it is necessary to multiply the CC. of acid used by 18·45.

4044. **HYDROCHLORIC ACID.** Solution containing 13·04 grammes of Hydrochloric Acid, equal to 10 grammes of Anhydrous Lime, and to 18·93 grammes of Anhydrous Carbonate of Soda, in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Lime. *Pint*, 2s.; *Half-gallon*, 6s.
4045. **SODIUM HYDRATE.** *Caustic Soda.* Solution containing 14·29 grammes of Sodium Hydrate in a Litre. 1 CC. is = 1 CC. of the Hydrochloric Acid No. 4044. *Pint*, 2s.; *Half-gallon*, 6s.
4046. **ESTIMATION OF SUGAR.**

The alkaline solution of Copper, No. 4050, is diluted and boiled. It is then tested with dilute urine, under the action of which the Copper solution loses its blue colour, and affords a coloured precipitate of cuprous oxide.

4047. *Process.*—Put 10 CC. of the Copper solution, No. 4050, into a mixing jar, such as 2798c; add to it 40 CC. of distilled water, and boil the mixture. In the meantime, dilute 10 CC. of urine with distilled water to the volume of 200 CC. With this diluted urine, fill a Mohr's Burette, and supply it thence gradually to the boiling solution of dilute Copper test. The first action of the test is to render the mixture turbid with a greenish or reddish brown precipitate, which does not settle readily. As the action proceeds, the precipitate becomes of a more decided red colour, towards the end it settles down more readily, and the liquid finally loses its blue tint, and becomes colourless. During the whole period of testing, the mixture is to be kept gently simmering. Should from time to time, after shaking the mixture, allow the precipitate to settle, and then pour the solution towards a window, or downwards towards the white slab, No. 2800. When the blue colour becomes faint, you must be cautious in adding urine, in order not to overdo. Finally, one or two drops take away the last residue of the blue colour, and the bright red precipitate settles down in the colourless mixture. The operation is then ended.

4048. *Control.*—Filter a few drops of the boiling mixture into 3 Test tubes. No. 1. Acidify with Hydrochloric Acid, and add Hydrosulphuric Acid. No. 2, Acidify with Acetic Acid, and add Solution of Ferrocyanide of Potassium. If the mixture in No. 1 blackens, or that in No. 2 becomes brown, the solution still retains copper. If both remain colourless, the copper has all been reduced. No. 3. To this tube add a few drops of the Copper solution, No. 4050, and heat to boil. If it gives a red precipitate, too much urine has been added. After these points have been determined, the analyses can be repeated easily, as the approximate constitution of the urine is now known.

4049. *Result.*—The 10 CC. of Copper solution used is equivalent to 50 milligrammes (0·050) of sugar. The experiment shows how many CC. of urine are demanded to supply this quantity of sugar. 200 CC. of the mixture, prepared for use in the burette, contain only 10 CC. of urine. The number of CC. shown by the scale of the burette must be divided by 20, to show the number of CC. of urine that contain 50 milligrammes of sugar.

4050. **FEHLING'S COPPER SOLUTION** for the estimation of **DIABETIC SUGAR**, containing 34·65 grammes of crystallized Sulphate of Copper, 173 grammes of Potash Tartrate of Potash and Soda, and 80 grammes of Caustic Potash, in 1 Litre. Of this solution 10 CC. = 50 milligrammes (= 0·050) of Diabetic Sugar. *Pint*, 4s.; *Half-gallon*, 15s.

4050a. This mixture is readily decomposed by the action of light, air, and carbonic acid, rendered fallacious in its indications. The following narrative affords an example of its spontaneous decomposition. It is given by Dr. BENICE JONES, in the *Medical Times and Gazette*, for Jan. 21, 1865:—

"A physician sent me some urine of a supposed diabetic patient, asking me to determine the amount of sugar. I told him I found no sugar present. He gave me an analysis, in which the amount was determined to the second decimal place. I took the urine I had examined to the analyst, and asked him to repeat his test. For convenience he had made a Winchester quart of Fehling's standard solution, and, on testing the urine, reduction occurred to an immense extent, and the analyst thought I was wrong, until I heated his standard solution without adding any urine. Then the tartaric acid reduced the oxide of copper just as if sugar had been present."

This difficulty can be overcome certainly for some time—though I cannot say for how long—by keeping the materials for the test mixture in two separate bottles, from each of which a precise quantity of liquor is measured by pipettes for every analysis that is to be made; as follows:—

4051 A. **COPPER SOLUTION.** Containing 34·65 grammes of crystallized Sulphate of Copper in a Litre. 10 CC. = 50 milligrammes (0·050) of Sugar.

051 B. TARTARIC ALKALINE SOLUTION. Containing 173 grammes of Tartrate of Potash and Soda, and 80 grammes of Hydrate of Potash, in a Litre. 10 CC. of this liquor are required for action with every 10 CC. of the Cupric solution, 4051 A. *A Pint bottle of each of these two Solutions, 5s.; Half-gallon Bottle of each, 16s.*

4052. METHOD OF USING THESE LIQUORS.—[*Variation of the Process described in No. 4047.*]—Into a mixing jar, No. 2798c, put 30 CC. of distilled water, 10 CC. of the Tartaric Alkali, No. 051 B; and 10 CC. of the Cupric Sulphate, No. 4051 A. Stir the mixture, and bring it to a boiling heat. Then proceed as directed in No. 4047.

053. LITMUS. *For the ascertainment of the NEUTRAL POINT in mixing Acid and Alkaline Liquors, LITMUS INFUSION is required. It should be occasionally prepared fresh, and may be kept in a pipette bottle, such as No. 2818. Bottle, with 2 ounces of dry Litmus, 1s.*

070. COLLECTION OF GRADUATED TEST SOLUTIONS FOR THE VOLUMETRIC ANALYSIS OF URINE, according to NEUBAUER and VÖGEL.

For particulars consult the articles referred to in the marginal numbers.

*** THE PRICE IS FOR A BOTTLE CONTAINING 1 PINT.

For the Estimation of Chloride of Sodium:—

- 004. Barytic Solution for precipitating Phosphates, 2s.
- 005. Mercuric Nitrate for estimating Chlorides, 3s.
- 006. Sodium Chloride, standard solution, 2s.
- 007. Urea, 1 ounce in bottle, 6s. 6d.
- 008. Sodium Sulphate, saturated solution, 2s.

For the Estimation of Urea:—

- 004. Barytic Solution, same as above, No 4004.
- 012. Mercuric Nitrate for estimating Urea, 3s. 6d.
- 013. Sodium Carbonate, saturated solution, 2s.
- 014. Urea. See No. 4007.

For the Estimation of Phosphoric Acid:—

- 023. Uranium Nitrate for precipitating Phosphoric Acid, 3s. 6d.
- 024. Sodium Super-Acetate, 2s.
- 025. Potassium Ferrocyanide, 2 oz. cryst. in bottle, 1s. 6d.
- 026. Sodium Phosphate, standard solution, 2s.

For the Estimation of Sulphuric Acid:—

- 034. Barium Chloride, 2s.
- 4035. Potassium Sulphate, 2s.

For the Estimation of Free Acid:—

- 039. Sodium Hydrate, 2s.
- 4040. Oxalic Acid, 2s.

For the Estimation of Lime:—

- 044. Hydrochloric Acid, 2s.
- 4045. Sodium Hydrate, 2s.

For the Estimation of Diabetic Sugar:—

- 051, A and B. Fehling's Copper Test, in 2 Pint bottles, 5s.

For the ascertainment of Acidity or Alkalinity:—

- 053. Litmus, 2 ounces in a bottle, 1s.

4071. THE SET OF 17 TEST LIQUORS, [See No. 4070,] IN PINT BOTTLES, 39s.

Dry substances in addition, 4007. Urea, 6s. 6d.

„ „ 4025. Ferrocyanide of Potassium, 1s. 6d.

„ „ 4053. Litmus, 1s.

4072. The complete set, 48s.

4074. APPARATUS REQUIRED FOR USE WITH THE FOREGOING GRADUATED T. SOLUTIONS, IN THE VOLUMETRIC ANALYSIS OF URINE.

*** Descriptions or Figures of the Instruments will be found in this Work at t Nos. referred to in the Margin.

COMPLETE SET OF APPARATUS, £4 4s.

Any single Instrument supplied at the Price quoted.

- 2688, 6. Pair of Mohr's Burettes, 35 CC. in $\frac{1}{10}$, at 4s. 6d.—9s.
- 2688, 7. Pair of Mohr's Burettes, 55 CC. in $\frac{1}{2}$, at 4s. 9d.—9s. 6d.
- 2698. Wooden support for a pair of Burettes, 5s. 6d.
- 2704. Metal support for a pair of Burettes, 6s. 6d.
- The prices of various supports for Burettes, single and double, will found between Nos. 2694 and 2711 in this work.
- 2768. Bulb Pipettes to deliver respectively 5, 10, 15, 20, 25, 50, 100 CC., 8s.
- 2769. Scale Pipette, for 20 CC. in $\frac{1}{5}$, 2s. 6d.
- 2769. Scale Pipette, for 50 CC. in $\frac{1}{2}$, 4s.
- 2798 a. Mixing Flasks, $\frac{1}{4}$ and $\frac{1}{2}$ pint, 1s.
- 2798 c. Mixing Jars, $\frac{1}{4}$ and $\frac{1}{2}$ pint, 1s. 6d.
- 2800. White glazed Slab to show up Colours in liquors under trial, 1s.
- 2813. Griffin's Quick Filter, *two*, 6d.
- 2814. Decanting Tube, *three*, 6d.
- 2815. Porcelain Testing Slab for Indicators, 1s. 6d.
- 2817. Small Test Glasses, *six*, 9d.
- 2818. Bottle for Litmus tincture, 1s.
- 1626. Funnels, 1 each, $1\frac{1}{2}$ inch, 2 inch, and $2\frac{1}{2}$ inch, 6d.
- 1626. 100 Circular Filters, $2\frac{3}{4}$ and $3\frac{3}{4}$ inches, to fit these funnels, 9d.
- 1626. Japanned Box to hold the Filters, 6d.
- 342. Black Wood Funnel Holder, 1s.
- 2427. Litmus Test Papers, 12 books in a box, 2s.
- 2400. Test Tubes, 6 inches by $\frac{3}{4}$ inch, *twelve*, 1s. 2d.
- 372. Support for 8 Test Tubes, 2s.
- 1466. Set of 8 Bohemian Glass Beakers, 4s.
- 115. Glass Stirrers, 3, 6, and 9 inch, 12 *assorted*, 6d.
- 1401. Boiling Flask, 1 each, 5, 10, 15, 20 ounces, 2s. 4d.
- 2783. Measuring Flasks, with a mark on the neck, for 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$ Litre, 8s.
- 2791, 7. Test Mixer for diluting liquors, 500 CC. in 100 spaces of 5 CC., 6s.
- 1726. Bottle for washing precipitate with hot water, 2s. 6d.

4075. VOLUMETRIC APPARATUS, *Limited set*, containing only the articles mo indispensable for the analysis of URINE. *The Set*, £2 2s.

The purchaser may enlarge this collection by selections from the collection, N 4074, so as to give it any degree of completeness that may suit his purpose.

- 2688. Mohr's Burette, 55 CC. in $\frac{1}{2}$, 4s. 9d.
- 2702. Iron Support for the Burette, 3s. 6d.
- 2768. Bulb Pipettes, to deliver 10, 15, 20 CC., *the set*, 2s. 10d.
- 2769. Scale Pipette, 25 CC. in $\frac{1}{2}$, 2s. 6d.
- 2769. Scale Pipette, 2 CC. in $\frac{1}{5}$, 1s.

2798. Mixing Jars, Nos. 3 and 9, 2s.
 2813. Griffin's Quick Filter, 3d.
 2814. Decanting Tubes, *three*, 6d.
 2815. Porcelain Slab for Indicating Tests, 1s. 6d.
 2817. Small Test Glasses, *six*, 9d.
 1626. Funnel, 1 each, $1\frac{1}{2}$ and 2 inch, 4d.
 — 100 Circular Filters for each size, 9d.
 — Japanned Box to hold the Filters, 6d.
 342. Blackwood Funnel Holder, 1s.
 2426. Box of Test Papers, 1s.
 2400. Test Tubes, 6 inch by $\frac{3}{4}$ inch, *six*, 7d.
 358. Support for 6 Test Tubes, 5d.
 465. Set of 5 Bohemian Glass Beakers, 2s. 6d.
 115. Glass Stirrers, 6 inch, *six*, 2d.
 400. Boiling Flasks, 1 each, 5, 10, 20 ounces, 1s. 2d.
 783. Measuring Flasks, 1 Litre and $\frac{1}{2}$ Litre, 4s. 6d.
 792. Jar on foot, $\frac{1}{2}$ Litre graduated into spaces of 5 CC., 5s.
 726. Bottle for washing precipitates, 2s. 6d.
 800. White glazed Slab to show up Colours in liquors under trial, 1s.
 818. Bottle and Pipette for Litmus tincture, 1s.

080. APPARATUS REQUIRED FOR MISCELLANEOUS OPERATIONS IN URINOMETRY.

I place here instruments required for various operations in the analysis of urine; some of them volumetric and others gravimetric; including those necessary for qualitative experiments.

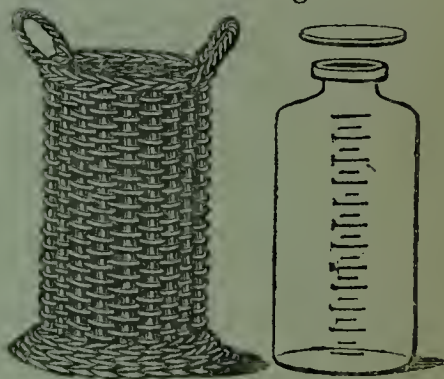
081. LARGE GLASS BOTTLE, 12 inches high, 5 inches wide, for collecting the urine of a patient during 24 hours; wide ground mouth, $2\frac{1}{2}$ inch bore, covered with a ground glass plate. Contents about 5 pints, or 3 Litres, graduated into spaces of 100 CC. Fig. 4081, 7s.

082. Similar Bottle, containing Five Pints, graduated into fluid ounces, 7s.

083. Similar Bottle, Five Pints, divided into Decigallons and spaces of 100 Septems, 7s.

084. Similar Bottle, not graduated, 2s. 6d.

085. Extra for Wicker Basket Case, for one of the Five pint bottles with handles, for Hospital use. Fig. 4085, 3s.



4085.

4081.

087. URINOMETERS [*Small Hydrometers*] for determining the specific gravity of Urine. See page 58. The Instrument recommended by Neubauer is that described at No. 633. It is more delicate, but much larger than the Instrument commonly used in England, No. 630.

088. Pycnometers, or Specific Gravity Bottles, for the more exact determination of the specific gravity of Urine, are fully described at page 47.

089. THERMOMETERS. See description of the following at page 45.

088. Thermometer, with Milk Glass Scale, to 100° C., 3s. 6d.

087. Thermometers for Testing the Heat of the Human Body in Fevers, &c.

Apparatus for the Application of Heat where Coal Gas is available:—

090. Rose Gas Burner, second size, No. 974, stoneware cylinder, No. 1210, and square of Wire gauze, No. 1196, and Sand bath, No. 1197, *together*, 6s. 6d.

This little furnace serves for boiling solutions in the mixing flasks, as required in many volumetric processes, also for evaporation in small porcelain basins; but if a red heat is required, as for the fusion of crucibles, the following furnace is preferable.

4091. Complete Gas Furnace, No. 985, with No. 2 Burner, and arrangements, for evaporating and igniting. *The set*, 20s.

Apparatus for the Application of Heat by means of Spirit Lamps:—

4092. Glass Spirit Lamp, No. 852, 1s. 4d. Cotton Wick, in a box, 2d. Stonewall Cylinder, No. 1191, 8d. Wire gauze, No. 1196, 2d. Sand bath, No. 1197, 4d.—*together*, 2s. 8d.
4093. Berzelius's Spirit Lamp on Stand, No. 870, for various degrees of heat, serving either for boiling flasks or for igniting crucibles, 16s. 6d.

A reference to the article on APPARATUS FOR THE PRODUCTION AND APPLICATION OF HEAT, commencing at page 71 of this work, will supply the reader with all farther necessary information on this subject.

- 1320, 3. Platinum Crucible, 1 inch diameter, $\frac{1}{2}$ oz. capacity, *about* 18s.
- 1321a. Capsule Cover for ditto, *about* 12s.
1323. Berlin Porcelain Crucibles, No. 0, 1, 2, 3, contents, $\frac{3}{8}$, $\frac{1}{2}$, 1, and 2 ounces, with Covers. *The set*, 3s.
1743. Berlin Porcelain Evaporating Basins:—

No. 2, 4 oz. $3\frac{3}{4}$ inch, 7d.	No. 5, 10 oz. $4\frac{3}{4}$ inch, 1s. 3d.
No. 3, 6 oz. 4 inch, 10d.	No. 6, 16 oz. 6 inch, 1s. 7d.

1296. Exsiccator, closed glass, to contain oil of vitriol, 4s. 6d.
1273. Air Bath, Fresenius's pattern, 21s.
121. Tongs for lifting hot Crucibles, bright iron, 1s. 6d.
4094. Burette for use with Solutions of Iodine or Chamæleon, which act upon caoutchouc pinchcocks.

The solutions described between Nos. 4000 and 4051 are not of this character; but when these solutions have to be used, the proper kinds of burette for use with them are those described in this work at Nos. 2689, 2731, 2736, 2739, 2740, and 2746. The capacity and graduation to be about 35 CC. in $\frac{1}{2}$ or 35 CC. in $\frac{1}{10}$.

1286. Desiccating Pan, for oil of vitriol, 8-inch, 1s. 3d.
1887. Trellis Top, 8-inch 1s. 9d.
657. Glass Cover, 9-inch wide, 5-inch high.... 4s.
1295. Square Glass Plate, 10-inch 3s.
1240. Porcelain Water Bath with Capsule, 5-inch, adapted to the gas or spirit lamp furnace described above, 2s. 6d.
4100. PURE CHEMICAL TESTS in Solution, necessary for the QUALITATIVE ANALYSIS OF URINE according to NEUBAUER and VOGEL; twenty tests, selected from the list at page 274, where the strength of the solutions is stated.

The prices quoted in the following list are for bottles that contain 2 fluid ounces.

4101. The set of 20 Tests in 2 ounce bottles, of class A, 13s.
4102. The set of 20 Tests in 2 ounce bottles, of class B, 21s. 4d.

	s.	d.		s.	d.
2447. Acetic Acid	—	10	2499. Ferric Chloride	—	—
2448. Alcohol	1	1	2510. Lead Acetate	—	—
2449. Ammon. Carbonate	—	7	2522. Nitric Acid	—	—
2450. Ammonia	—	6	2523. Oxalic Acid	—	—
2453. Ammon. Oxalate	—	8	2536. Potassium Hydrate	—	—
2462. Barium Chloride	—	6	2540. Potassium Sulphocyanide	—	—
2470. Calcium Chloride	—	6	2550. Silver Nitrate	1	—
2471. Calcium Hydrate	—	6	2555. Sodium Acetate	—	—
2477. Copper Sulphate	—	6	2560. Sodium Hydrate	—	—
2496. Hydrochloric Acid	—	7	2571. Sulphuric Acid	—	—

1106. APPARATUS and TEST LIQUORS for the Volumetric estimation of Urea, Chlorides, Sulphates, Phosphates, and Sugar, in URINE, according to LIEBIG, as described by Dr. M. von BOSE, in Dr. BEALE'S *Archives of Medicine*, for 1858.

The corrections made upon the processes described in the above paper consist in putting the solution for Fehling's Copper Test for Sugar into two bottles, for the reasons stated at No. 4050a in his work, and in supplying the test liquors Nos. 4023, 4024, and 4026, for testing phosphoric acid by uranium, instead of those necessary for the iron test.

Contents of the Collection :—

A. GRADUATED TEST SOLUTIONS.—1 pint of each in a stoppered glass bottle. The marginal numbers refer to the descriptions in the preceding pages.]

- | | |
|---|--|
| 005. Mercuric Nitrate for Chlorides. | 4023. Uranic Nitrate for Phosphoric Acid. |
| 012. Mercuric Nitrate for Urea. | 4026. Phosphate of Soda Standard Solution. |
| 004. Baryta Solution to separate Phosphates. | 4024. Super-acetate of Sodium. |
| 051A. and 4051B. Fehling's Copper Test for Sugar. | 4034. Barium Chloride. |
| 013. Sodium Carbonate. | 4008. Sodium Sulphate. |
| | 4025. Potassium Ferrocyanide in Crystals. |

B. APPARATUS.

- | | |
|--|---|
| Two of Mohr's Burettes, 50 CC. in $\frac{1}{2}$ CC. | 6 Glass Stirrers, 6-inch. |
| Two Wooden Supports for the Burettes. | Spirit Lamp, 4 ounce. |
| Bulb Pipette to deliver 25 CC. | Tripod Stand, No. 295. |
| Jar on foot, with Spout, $\frac{1}{2}$ Litre in 100 divisions. | Sand Bath, 5-inch. |
| Beale's Filter. | Funnels, 2-inch and $1\frac{1}{2}$ -inch. |
| Berlin Porcelain Basin, 3-inch. | Black Wood Funnel Stand. |
| Ditto, 4-inch. | 100 Filters for each Funnel. |
| Test Paper Books, red, blue, and neutral. | Japanned Box for the Filters. |
| Set of 5 Beaker Glasses. | Piece of Muslin for filters. |
| | 2 extra Caoutchouc Burette Joints. |

107. The above Collection of Apparatus and Test Solutions, complete, but not packed, £3 3s.
108. The same, arranged in a divided cabinet of pine wood, stained black, £4 4s.
109. APPARATUS and GRADUATED TEST SOLUTIONS for the estimation of DIABETIC SUGAR, according to the process of Dr. PAVY, as described in his work, "*Researches on the Nature and Treatment of Diabetes*;" London, 1862. Comprehending the articles from No. 4109 to 4115, the set, 21s. 9d. Separately as follows :—

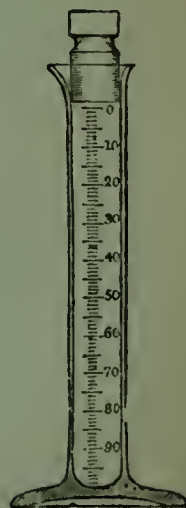
- 109A. CUPRIC SULPHATE SOLUTION, of such strength that 100 minims of it are decomposed by $\frac{1}{2}$ grain of Diabetic Sugar.
- 109B. TARTARIC ALKALINE SOLUTION, corresponding in strength to the Cupric Sulphate Solution 4109A.

A Pint of each Solution, in Stoppered Glass Bottles, the pair, 5s.

APPARATUS FOR USE WITH THE ABOVE SOLUTIONS.

110. Scale Pipette, Fig. 2769a, graduated to 100 minims, 2s. 6d.
111. Bulb Pipette, to deliver 100 minims, 1s. 9d.
112. Graduated Measure, Stoppered, with 100 marks, in which Urine can be diluted with water, as directed by Dr. Pavy, Fig. 4112, 3s.
113. Lamp Furnace, or Boiling Apparatus, consisting of a spirit lamp, a stoneware cylinder, wire gauze top, and a $3\frac{1}{2}$ -inch Berlin porcelain Evaporating Basin, 2s. 6d.
114. Mohr's Burette, No. 2688, 49, graduated to 100 minims, for use instead of the Pipette 4110, 3s. 6d.
115. Clamp Support for the Burette, No. 2697, 3s. 6d.

The articles No. 4114 and 4115 are not prescribed by Dr. Pavy, but are here commended as having (over No. 4110) the advantage of leaving the operator's hands liberty to attend to the heating and shaking of the mixture.



Dr. PAVY'S APPARATUS, *continued*:—

4117. Pavy's Apparatus for experiments on the Fermentation of Sugar with Yeast, consisting of a conical jar Water Bath, a glass tube still, a bent glass Connector, and a test glass, Fig. 3 in his book, 2s.

4118. *Dr. Pavy's Process*.—The urine to be tested is well mixed, a portion is diluted with water in the tube No. 4112, from 1 part to 5. With this diluted urine, the scale pipette, No. 4110, or burette, No. 4114, is filled. 100 minims of the copper solution, No. 4109A, are measured out into the porcelain capsule, No. 4113, 100 minims of the alkaline tartaric solutions, No. 4109B, are added, and the mixture is made to boil gently over the lamp furnace, No. 4113. The diluted urine is slowly dropped in from the graduated pipette or burette. When the hot mixture loses its blue color and the protoxide of copper is thrown down in the capsule as a bright red powder, the operation is ended. The number of Septems of urine used to produce this effect represent $\frac{1}{2}$ grain of sugar. As the urine was diluted from 1 volume to 5 volumes, of course the undiluted urine is 5 times as strong in sugar. The number of minims of urine which contain $\frac{1}{2}$ grain of sugar being thus found, it is easy to calculate the quantity of sugar in any measure of urine, reckoning 480 minims to the fluid ounce, and 20 fluid ounces to the pint.

4119. APPARATUS and TESTS for the Qualitative Analysis of URINARY DEPOSITS according to the processes of Dr. GOLDING BIRD, as described in his work on "*Urinary Deposits*."

4119. The following Collection complete, *but not packed*, 30s.

4120. The same, arranged in a mahogany cabinet, 52s. 6d.

4121. *Contents*:—LAMP FURNACE, consisting of a Spirit Lamp, Lamp Cylinder, Pair of Wire Rings, Wire Trellis, Sand Bath, Water Bath, and support for tubes on the Sand Bath; Three Water Glasses, Three Porcelain Capsules, Eight Test Tubes, Three Stirrers, Funnel and 100 Filters, Filter Rings for filtering without a funnel, Porcelain Crucible, Platinum Capsule and Tongs for holding it; Gravimeter for testing specific gravities, with solution Tube in Case; Three Books of Neutral Test Paper, which indicate either the acidity or alkalinity of urine; Balance and Weighing Graduated Measure to show half-draehms; Four Glass Slides, with cells, for use in testing small quantities of liquids; Glass Pipette; Two Test Tubes, 4 by 1 inch; Lamp Wick. And the following Tests in stoppered bottles:—Hydrochloric Acid, Nitric Acid, Solution of Caustic Potash, Liquid Ammonia, Fused Chloride of Zinc, Nitrate of Barytes, Nitrate of Silver, Oxalate of Ammonia, Sulphate of Copper, Carbonate of Ammonia, Acetic Acid.

Blowpipe Apparatus

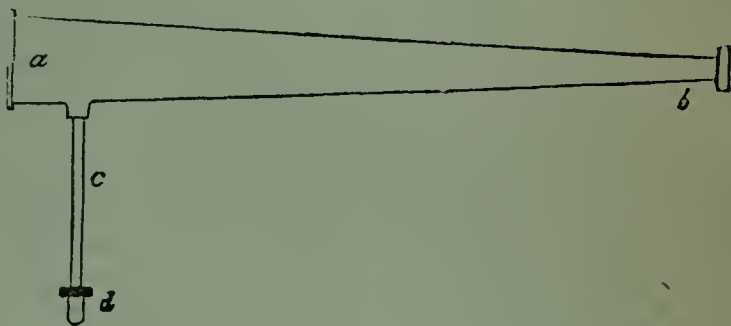
And Apparatus for Micro-Chemical Operations.

BLOWPIPES.

10. CONICAL BLOWPIPE, Fig. 4200. GRIFFIN'S modification of BLACK'S Blowpipe, japanned tin plate, *a*, *b*, with brass pipe, *c*, and moveable brass nozzle, *d*, 7 inches long, price 8d.

11. Ditto, same pattern, but $8\frac{1}{2}$ inches long, 8d.

This form of blowpipe is easier to use than instruments of smaller internal dimensions. The choice of the length depends upon the eyesight of the person who is to use the blowpipe. An instrument that is found to be too short, may be lengthened by a bit of vulcanised rubber tube put on the end *b*.



4200.

12. Conical Blowpipe, Griffin's form, Fig. 4200, made of German silver finely polished, with a platinum nozzle, 10s.

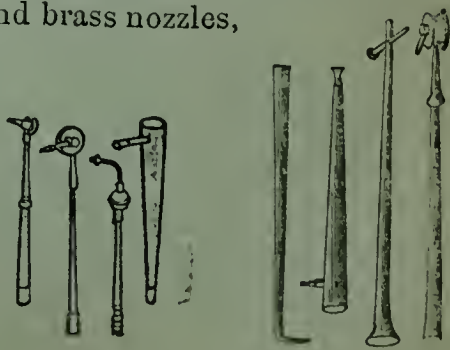
13. Blowpipe of the form used by Berzelius, Plattner, and Regnault, Fig. 4203, brass, with two brass nozzles, 5s.

13 a. Plattner's Blowpipe, form of Fig. 4203, made of highly-polished German silver, with expanding horn mouthpiece and 3 solid platinum jets, 18s.

14. Conical Blowpipe, of smaller capacity than No. 4200, made of polished brass, with bone mouthpiece and brass nozzles, Fig. 4204 *d* and *f*, 2s.



4203.



4204.

4205. Conical Blowpipe, without condenser or separate nozzle, Fig. 4204 *e*, brass, not polished, 6d.
4206. Bergmann's Blowpipe, with spherical condenser, Fig. 4204 *c*, brass, with brass nozzle, 2s.
4207. Bergmann's Blowpipe, Fig. 4204 *c*, with ivory mouthpiece and two brass nozzles, 3s.
4208. Tennant's Blowpipe, with flattened cylindrical condenser, Fig. 4204 *b* and *d*, made of brass, with ivory mouthpiece and two brass nozzles, 5s.
4209. Portable Blowpipe, as used by Wollaston and Mitscherlich, which folds into the size of a small pencil-case for the pocket, Fig. 4204 *a* and *g*, made of brass, 3s. 6d.
4210. Portable Blowpipe, same as last, but made of German silver, 4s. 6d.
4211. Griffin's Flexible Blowpipe, by means of which the volatile products of blowpipe combustion can be blown in any desired direction, form of Fig. 4211, very portable, 1s.

The tube and nozzle, *a*, are of brass; *b* is a flexible caoutchouc blowing tube; *c* is a cork by which the blowpipe is held and directed.

4212. Griffin's Flexible Blowpipe, with condenser, form of Fig. 4212, 3s.

The cylinder *c* by which the blowpipe is held, is of brass, about 1 inch in diameter and 1½ in length; the nozzle *a* is of brass, the blowing tube *b* of caoutchouc. In consequence of the large size of the reservoir *c*, this blowpipe is easier to use than the more portable blowpipe, 4211.

NOZZLES AND MOUTHPIECES FOR BLOWPIPES.

4213. Nozzles for Blowpipes, brass, such as *d* Fig. 4200, each 4d.
4214. Nozzles of Brass tipped with Platinum, each 1s. 6d.
4215. Nozzles of Solid Platinum, each 2s. 6d.

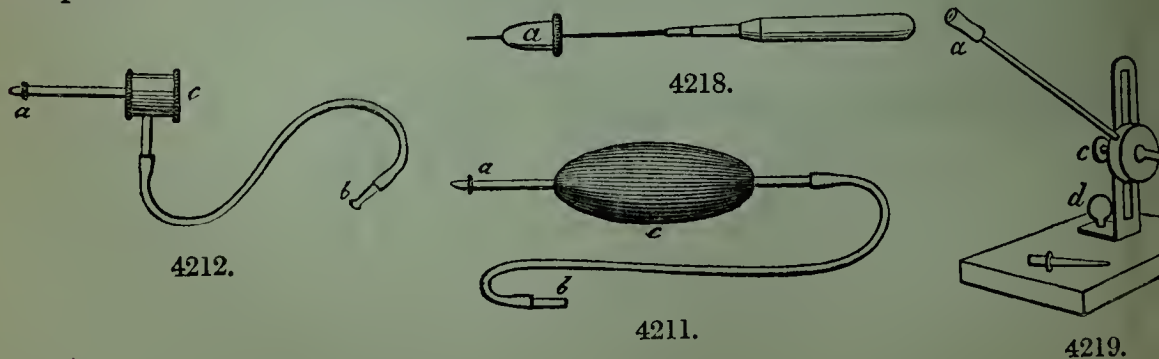
The nozzles of solid platinum possess the advantage that when stopped in the bore by oil or they can be easily cleansed by being heated to redness on charcoal before the blowpipe.

4216. Mouthpiece for a Blowpipe, cylindrical form, made of polished bone, 6d.
4217. Plattner's Trumpet-formed Mouthpiece for Blowpipes, polished bone, 1s.
4218. Blowpipe Drill, of hard steel, four-square, with sharp edges, in handle; for opening the orifice of the nozzle of the blowpipe when stopped by oil, Fig. 4218, 8d.

In using the drill, the jet should be taken from the blowpipe, and the drill be inserted into the orifice, from within the jet, as shown by Fig. 4218. It must be used gently, in order not to make the hole too large.

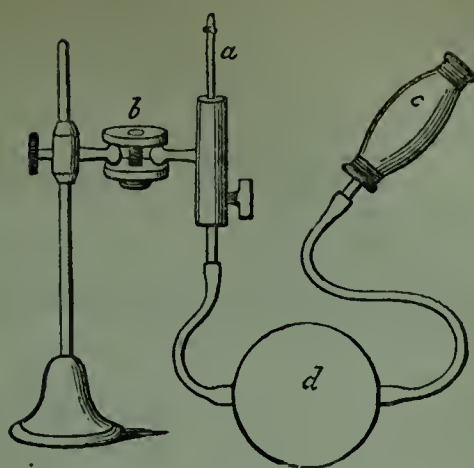
4219. Brass Blowpipe, fixed on a stand, Fig. 4219, 10s. 6d.

This blowpipe can be fixed in any desired position; higher or lower in the upright slide, at any angle from the table. The blowpipe is fixed to the support by the screw *c*, and the frame is raised or lowered by the screw *d*. The jet *b* is in duplicate, with orifices of different sizes. At *a* is a mouthpiece.



20. Blowpipe fixed to a support, and accompanied by a caoutchouc blowing apparatus, Fig. 4220, price 25s.

Fig. 4220, letter *c*, represents a blowing machine to be worked either by the hand or the foot: it forces air into the expanding regulator *d*, and thence in a regular stream into the blowpipe *a*. The force of the blast is regulated by the stopcock which forms part of the blowpipe. The position of the blowpipe and the direction of the blast are regulated by the universal joint *b*, and the thumb-screw and collar on the support.



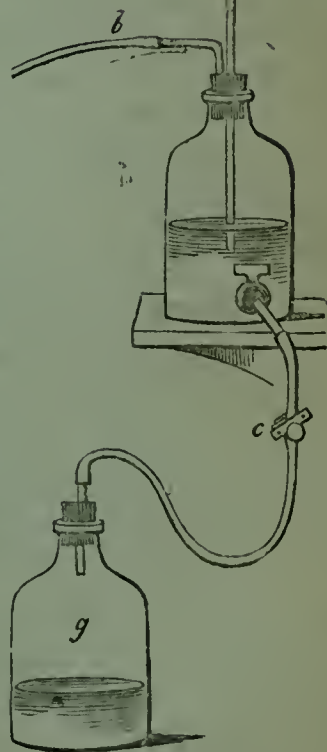
4220.

21. Sprengel's Catalan Blowpipe, which gives a constant stream of air sufficient for all analytical operations with the blowpipe, complete as represented in Fig. 4221, with the omission of the two bottles *f* and *g*, 12s.

22. The same, with the addition of the two stoneware water bottles, 2-gallon size, with brass taps, 24s.

Other sizes of water bottles are described at page 22. A smaller size than two gallons does not give air enough for a long blowpipe operation. Larger sizes are troublesome to lift up when full of water.

4223. *Action of Sprengel's Blowpipe*, Fig. 4221. Suppose the central bottle or regulator (of one gallon capacity) to be half full of water, so as to cover the lower end of the pipe *a*, the bottle *f* to be full of water, and the bottle *g* to be empty. Then, if you open the stopcock between *f* and *d*, the water runs from *f* into the regulator, and thence into the bottle *g*. By a proper adjustment of the clamp *c* (see No. 2871), the water can be made to run from the regulator into *g*, as fast as it runs from *f* into the regulator, so that the water in the regulator remains nearly at the same level. When this is the case, air enters by the tube *e*, bubbles up through the water in the regulator and escapes by the tube *b*. If the flow of the water is well regulated by the stopcock *d* and the clamp *c*, the current of air is quite regular, and sufficiently powerful for most blowpipe experiments. To use it, the blowpipe is simply attached to the caoutchouc tube which is connected with the bent tube *b*. It serves for most of the mouth blowpipes, and for the gas blowpipes (Nos. 4250 and 4252). If the water passes out of the regulator less rapidly than it passes into it, the pressure of the air is increased, but the gain of power is only of short duration, because the regulator then rapidly fills with water. When the water has all run from *f* to *g*, the bottles *f* and *g* must be made to change places. The bottle *g* is provided with a neck and stopcock that are not represented in the figure.



4221.

BLOWPIPE LAMPS.

4226. Blowpipe Lamp, form of Fig. 4226, made of japanned tinplate, with pull-off cap and support for the fingers, 1s.

a is the lamp; *b*, the wick-holder; *c*, a cylinder holding a perforated cork, by which the lamp is held on a wooden support, as represented by Fig. 4228; *d* is a support, the right hand side of which supports the hand that holds the blowpipe, while the left hand side supports the hand that holds objects in the blowpipe flame.

4227. Blowpipe Lamp, similar to the above, with collar and thumbscrew to attach it to a slender brass support, the support being such as is represented by Fig. 4232, although in that figure the cork support is represented, 1s. 4d.

4228. Wooden Support for the Lamp, No. 4226, form of Fig. 4228, black wood, 8d.

4229. Wooden Lamp Support, same pattern, mahogany, 1s.

4230. The Lamp, No. 4226, with the black wood support, as represented by Fig. 4228, 1s. 8d.

4231. The Lamp, No. 4226, with the mahogany support, 2s.

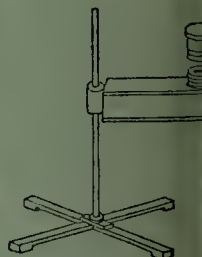
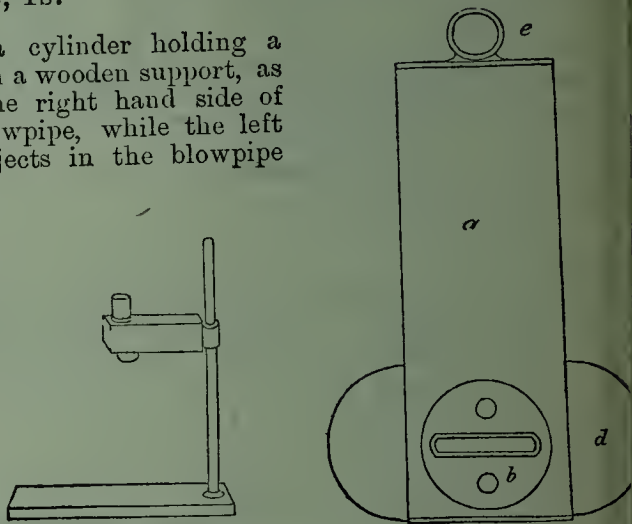
4232. Blowpipe Lamp, japanned tinplate, with brass cap to screw on, and prevent escape of oil in travelling, form of Fig. 4232, but with collar and thumbscrew, similar to that shown by Fig. 4233, to adjust it to the brass rod, 2s. 6d.

4233. Blowpipe Lamp, japanned tin-plate, form of Fig. 4233, having an extra neck to admit of the addition of oil without disturbing the wick-holder; both necks provided with brass screw caps. Also with finger-plate and brass collar and screw, 3s.

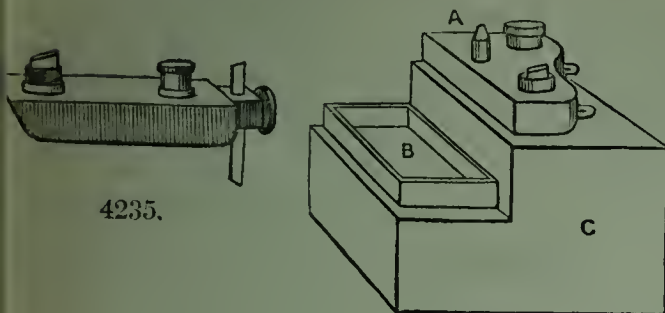
4234. Blowpipe Lamp, polished brass, with one neck, like Fig. 4232, but with collar and thumbscrew, 5s. 6d.

4235. Blowpipe Lamp, Plattner's pattern, Fig. 4235, polished brass, with extra opening for oil, brass screw caps to both necks, with collar and thumbscrew, 7s. 6d.

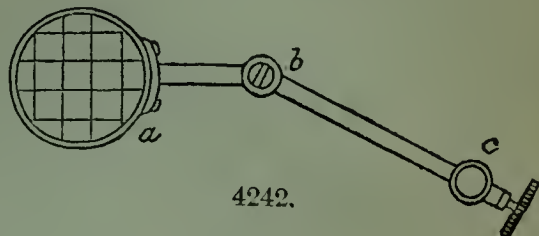
4236. Laboratory Blowpipe Lamp, for use where Gas is unattainable; form of Fig. 4236, made of japanned tinplate, with three necks; the large one the usual large flat blowpipe wick, the small one for a single small round wick, to be used when a small flame is required for experiments phosphorescence and coloured flames; the third neck for the insertion of oil; all three necks provided with pull-off caps, 2s. 6d.



237. Table to support the Laboratory Blowpipe Lamp, form of Fig. 4236, consisting of a wooden box C, upon the top of which the lamp A can be screwed. B is a tinplate tray, the bottom of which should be covered with a plate of glass, to receive objects that fall from the blowpipe. The box C can be fitted with drawers to hold the blowpipe apparatus. These drawers may be made to pull out, either in front or on the right hand side. Price according to style of fitting up.



4236.



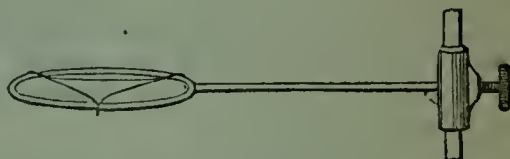
4242.

241. Portable Brass Support for the Blowpipe Lamp, as used by Berzelius and Plattner, and represented in Fig. 4232, in three pieces, polished brass, formed to unscrew and fold up for travelling, 3s.

This support suits all the Lamps that are described as being provided with a brass collar and thumbscrew.

242. Plattner's Support for small capsules over the Blowpipe Lamp, or the Spirit Lamp, Fig. 4242, consisting of a brass ring with iron or brass trellis, adapted by a collar and thumbscrew to the rod of the brass support, No. 4241, or Fig. 4232. Price of the branch as represented by Fig. 4242, 6s.

243. Crucible Support for use with a vertical Blowpipe flame, form of Fig. 4243, consisting of an iron ring, arm, and thumbscrew, adapted to the Support No. 4241, the iron ring fitted with a triangle, for sustaining crucibles, &c., that are to be ignited, 3s.



4243.

244. FUEL FOR BLOWPIPE LAMPS.

1. Mix alcohol of 85 per cent. 6 volumes, Spirit of Turpentine 1 volume, with a few drops of her.

2. Mix Wood spirit 4 volumes, with turpentine 1 volume.

Both must be clear, without excess of turpentine. With these mixtures a blowpipe has power to melt 30 or 40 grains of copper, or 300 grains of silver.

Duflos recommends for the production of a good reducing flame a mixture of 12 parts of strong spirit of wine with 1 part of turpentine.

Plattner uses refined olive oil, but rejects any that gives a blowpipe-flame with a yellow edge.

245. Japanned Metal Bottle for carrying Oil to feed the Blowpipe Lamp, form cylindrical, 5 inches long, $1\frac{1}{2}$ inch wide, with brass screw cap, 3s. 6d.

246. Similar Bottle to carry spirits of wine, 3s. 6d.

247. SPIRIT LAMP, glass, small size, for heating glass tubes and glass bulbs in the examination of substances for water and volatile compounds. Any of those described at page 79, at from 1s. upwards.

The lamp with rack, No. 860, is very handy for the regulated evaporation of small quantities of solutions; but it is too large for portable cabinets of blowpipe apparatus.

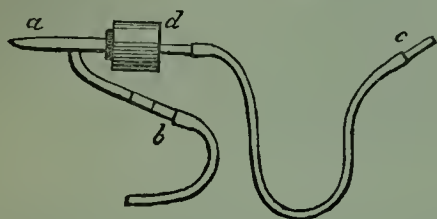
248. Glass Spirit Lamp, small size, with brass cap, ground to fit the glass neck to prevent the escape of spirit in travelling, 2s. 6d.

249. Cotton Wick for Blowpipe Lamps and Spirit Lamps, $\frac{1}{2}$ inch wide, per yard, in a box, 2d.

GAS BLOWPIPES AND GAS BURNERS.

4250. MOUTH BLOWPIPE attached to a GAS BURNER, form of Fig. 4250; brass, with caoutchouc blowing tube, 4s. 6d.

a, Fig. 4250, is the jet; *b* is the supply pipe for the coal gas; *c* is the flexible blowpipe, the end of which is placed in the operator's mouth; *d* is a cork, by which the blowpipe is held in the fingers. The brass tube connected with the blowing tube, *c*, can be moved backwards and forwards, in the jet pipe *a*, to regulate the size of the flame and adapt it either for oxidising or reducing. Of course the force of the jet of coal gas which feeds *b* must be regulated by a stopcock.



4250.



4251.

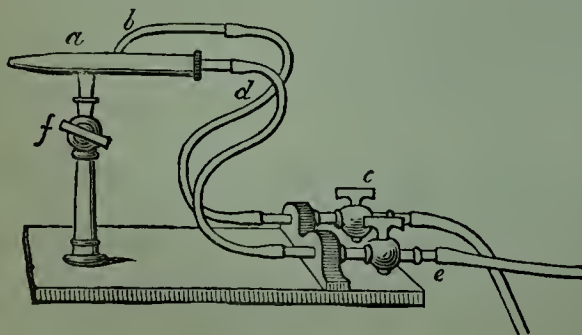
4251. Mouth Blowpipe, attached to a Gas Burner, another form, Fig. 4251, 3s.

The long tube is placed in the mouth. The coal gas arrives by the short tube represented on the left hand.

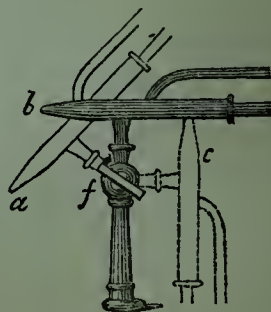
4252. GRIFFIN'S BLAST GAS BLOWPIPE, for Analytical Experiments on Chemicals and Minerals; consisting of a Brass Blowpipe and Stand, with two fine stopcocks, mounted on a japanned iron base, as represented by Fig 4252, 21s.

4253. This Blowpipe gives a clear and steady blue flame for any length of time, when used with an effective blowing apparatus; and the flame can be made at will, either large or small, oxidating or reducing, by a proper regulation of the supplies of gas and atmospheric air. It is, therefore, suitable for the performance of the various qualitative and quantitative blowpipe experiments that have been described by Berzelius, Plattner, and others,—leaving the operator's mouth and both his hands perfectly at liberty.

4254. The blowpipe *a*, Fig. 4252, is supplied with coal gas by the tube *b c*, and with air by the tube *d e*, which has a slight motion *towards* and *from* the point of the jet, by means of which the proper mixture of the air and gas is made, which is necessary to produce either oxidation or reduction as may be required. The supply of coal gas is regulated by the stopcock *c*, and that of air by the stopcock *e*; the former being, of course, connected with the gas main, and the latter with the blowing machine. An excellent blowing machine for this purpose is that described at No. 1166. Another, still more powerful and regular, but also somewhat higher in price, is No. 1168. A much cheaper, and quite efficient for many purposes, though not so convenient a blowing apparatus, is described at No. 4221. Whichever of these machines is used, it must be put into complete working order before the commencement of any blowpipe experiment, that is to last for some minutes, in order that no interruption of the experiment may take place. No blowing machine will answer that does not, like those referred to, give a perfectly steady blast.



4252.

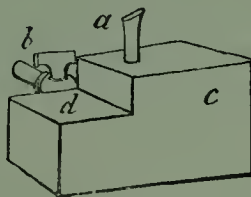


4255.

255. The blowpipe can be fixed by the screw *f*, Fig. 4252, in any required position, as exhibited Fig. 4255. Thus, if the flame is to be blown *downwards* upon an object to be heated on charcoal, in many blowpipe operations, the position *a* is adopted. If the flame is to be forced *horizontally*, as required for many experiments on coloured flames, or as it is used by Plattner in the roasting of metallic ores in his charcoal furnace, No. 4330, the position *b* is chosen. If an upright flame is required for the ignition or fusion of substances in a spoon or a crucible, or for certain experiments on bodies that produce coloured flames, then the position *c* is to be arranged. In moving the blowpipe from one to another of these positions, care must be taken that no *kink* is made in the catch-tubes *b* and *d*, so as to cut off the supply of gas or of air. This blowpipe readily melts metallic silver in a small crucible, and also a few grains of copper. Any crucible of less than an inch in height can be brought over it to a bright red heat. It answers well for the roasting of metallic ores, or for the decomposition of siliceous minerals in small quantities for qualitative analysis, or even for quantitative analyses after Plattner's methods.

6. BLOWPIPES OF A LARGER SIZE. See page 121 of this work, and the section on Blast Gas Furnaces commencing at page 104.

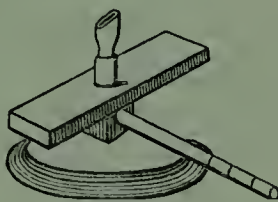
6. Gas Burner for the supply of Coal Gas for Blowpipe Experiments, mounted on a solid heavy block of wood, upon which the fingers may be steadied, while holding the blowpipe and the assay to the flame, form of Fig. 4256, with a stopcock for regulating the flame, 4s.



4256.

. Ditto, the same apparatus, without the stopcock, 2s. 6d.

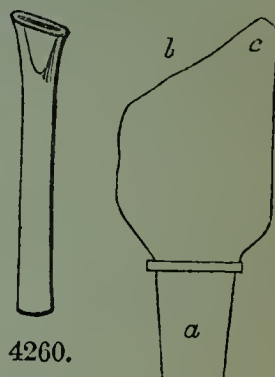
. Gas Burner for the supply of Coal Gas for Blowpipe Operations, with heavy iron foot, and wooden platform upon which to rest the fingers while holding the blowpipe and the assay to the flame. Fig. 4258, 2s.



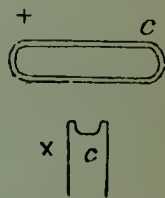
4258.

The same Arrangement, with the addition of a stopcock, 3s. 6d.

Bunsen's Blowpipe Burner, Fig. 4260, 6d.



4260.



4261.

acts when dropped into a Bunsen's jet so as to cut off the supply of atmospheric air and luminous gas flame. See page 91.

Massive Gas Burner for Blowpipe use, the lower part ground to fit an ordinary gas nozzle, Fig. 4261, 1s. 6d.

PORTS FOR OBJECTS IN THE BLOWPIPE FLAME.

There are four kinds of Supports, namely:—1, Metallic; 2, Charcoal; 3, Clay; 4, Glass.

1. METALLIC SUPPORTS.

PLATINUM WIRE of the proper thickness for Blowpipe Experiments, in pieces two inches long, Fig. 4270, each 2d.

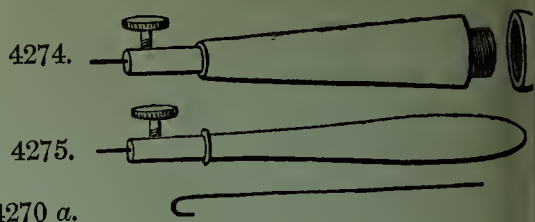
Platinum Wire, rather thicker than the sort commonly used for Blowpipe Experiments, in pieces two inches long, 2d.



4270.

4272. Platinum Wire, extremely fine, for holding very minute quantities, in experiments on the colours of flames, in pieces twelve inches long, 6d.
4274. Support for mounting short pieces of wire, Fig. 4270 *a*, serving also as a box in which to store the wires, Fig. 4274, 2s. 6d.
4275. Handle for Mounting Platinum Wires, but without a box for storing the wires, Fig. 4275, 1s.
4276. Copper Wire, for determining the presence of chlorine, iodine, and bromine, Fig. 4276, per yard, 2d.

Coil up the end of the fine Copper Wire, in the form shown by Fig. 4276; and melt a little microcosmic salt in this grate, using only a gentle heat. When the bead has done effervesce and has acquired a pale green colour, add to it a very small portion of the salt to be tried, expose the bead to the point of the blue flame. If chlorine is present, a bright blue flame appear; if iodine, an emerald green flame; if bromine, a blue flame with green edges.



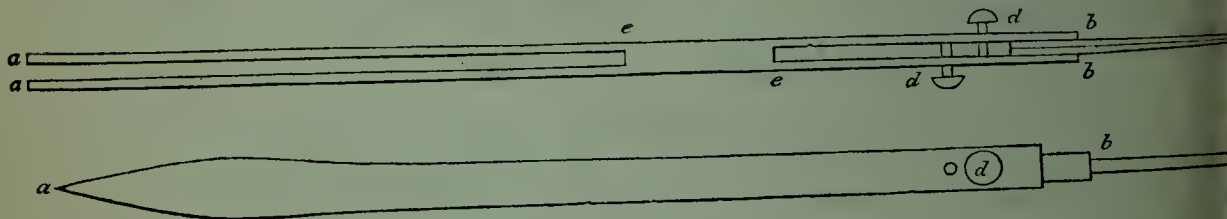
4276.



4280.

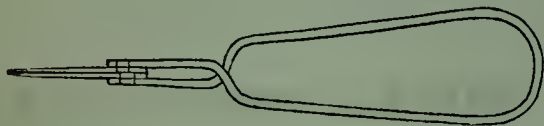
4277. PLATINUM FOIL of a proper thickness for blowpipe experiments, slip two inches long by half inch wide, 6d.
4278. Ditto, two inches long by 1 inch wide, 1s.
4279. Ditto, any length in slips of two inches wide, at per square inch, 6d.

Fig. 4280 represents a small slip of platinum foil, mounted in a Bohemian glass tube, for determining the presence of fluorine. The fluoride is added to a fused bead of microcosmic salt, which is placed on the bit of platinum. The flame is then to be so applied as to drive the disengaged gas into the glass tube, into the other end of which a piece of wetted Brazil wood paper is inserted. Hydrofluoric acid corrodes glass, and gives a yellow colour to Brazil paper.



4281.

4281. PLATINUM BLOWPIPE TONGS, best construction, size and form of Fig. 4281, consisting of flat steel blades, with hardened points, *a a*, and Platinum Points at the other end, *b c*, 7s. 6d.



4282.

4283 *a*.

4282. Steel Spring Tongs, with Platinum Points, form of Fig. 4282, but not twice the size of that figure, the steel flattened as shown by Fig. 4283 *b*, 3s. 6d.

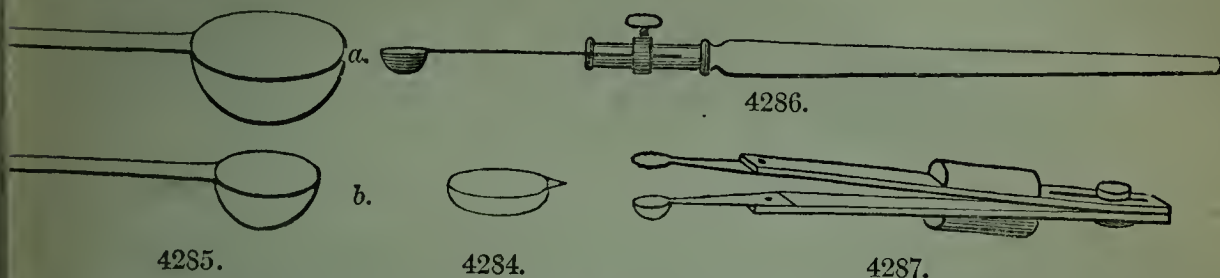
4283. Steel Spring Tongs, for holding small capsules before the blowpipe, or in the flame of the spirit lamp, Fig. 4283 *a*, which shows a platinum capsule; No. 4284, Fig. 4283 *b*, which shows an iron spoon, No. 4291, 6d.

4283 *b*.

PLATINUM SPOONS:—

4. PLATINUM SPOONS, or cups with short handle, form of Fig. 4284. These have been fully described at pages 185 and 186.

Fig. 4283 *a* represents the method of holding such cups in the flame, by which arrangement they are made to serve the purpose of spoons.



5. Plattner's Platinum Blowpipe Spoons, with very deep bowls and long handles, as represented by Figs. 4285 *a* and *b*, both as to form and size.

5 *a*. Price of the large spoon, 7s.

5 *b*. Price of the small spoon, 4s.

6. Plattner's Support for Blowpipe Spoons with long handles, brass mount on turned hard wood handles, Fig. 4286, 2s.

7. Spoon and Cover for exposing to heat substances that decrepitate; spoon and cover both of platinum, mounted on brass, Fig. 4287, 6s.

8. Double Cups for the same purpose, Fig. 4284, $\frac{3}{8}$ inch, *per pair*, 2s.

When in use, the pair of cups, placed mouth to mouth, is to be held by the tongs, No. 4283.

9. Plattner's Platinum Capsule, $1\frac{1}{4}$ inch diameter, $\frac{1}{2}$ inch deep, *about* 12s.

See pages 185 and 186 for other sizes.

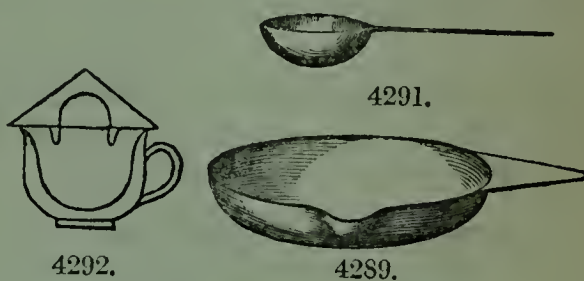
10. Cover for the Platinum Capsule, consisting of a $1\frac{1}{2}$ inch square of platinum foil, 1s. 6d.

This capsule is used when filters that contain small precipitates are to be burnt, and for decomposing oxides in sulphuric acid.

11. Iron Spoon, 1 inch bowl, short handle, Fig. 4291, for trying the combustibility of bodies, 2d.

When in use it is held by spring steel tongs as shown by Fig. 4283 *b*.

12. Cup and Cover of Berlin porcelain, with handle, for the ignition of decrepitating substances, $\frac{1}{2}$ inch diameter, Fig. 4292, 3d.



2. CHARCOAL SUPPORTS.

1. Sticks of Charcoal for use as Supports before the Blowpipe, *per lb.* 3d.

2. Saw for Cutting Sticks of Charcoal into pieces fit for Blowpipe Experiments, such as the disc marked *c* in Fig. 4302, or into square prisms of any desired size, 1s. 6d.

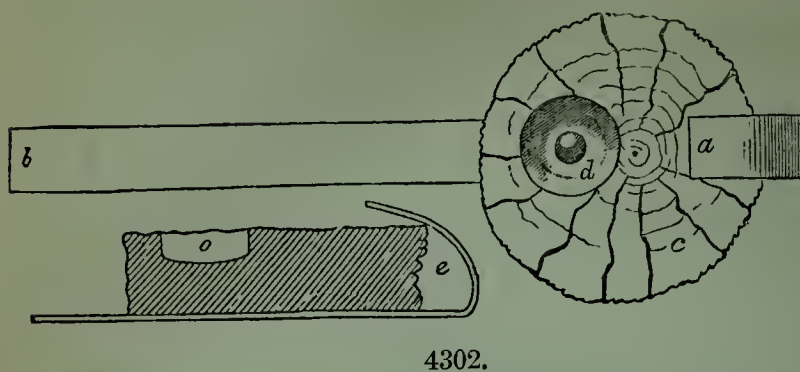


Charcoal Borer, to scoop cavities in charcoal for

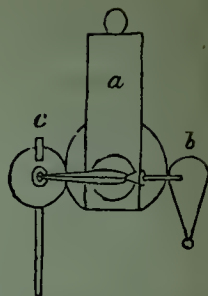
4301.

supporting Assays before the blowpipe, form and size of Fig. 4301, japanned tinplate, 4d.

4302. Charcoal Holders, tinplate slips, *a*, *b*, Fig. 4302, *per pair*, 1d.

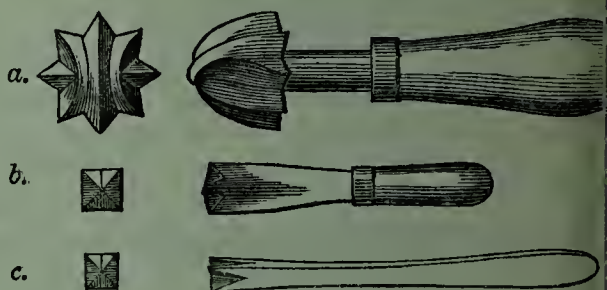


4302.



4303.

4303. Fig. 4302 represents a disc of charcoal mounted for use with the blowpipe. *c* is the disc of charcoal, cut from a stick by the saw, No. 4300. *d* is a hole scooped out by the charcoal borer, 4301. In the middle of the hole is the figure of an assay fused into a bead. *a*, *b* is the tinplate charcoal holder, No. 4302. The lower figure, *o*, *e*, represents a section of the charcoal disc, of the tin holder, both represented the full size. Fig. 4303 represents the arrangement proper for an experiment. *a* is the blowpipe lamp, No. 4226; *b* the blowpipe, No. 4200; and *c* the charcoal disc, and its tin holder, No. 4302.



4304.

4304. Plattner's Charcoal Borers, for making in Charcoal Sticks, or in Charcoal Pastilles, holes of various dimensions; the steel borers all made of hardened steel; three forms and sizes, Fig. 4304, *a*, *b* *c*. The kinds *a* and *b* with cocoa handles, *c* with spatula end.

4304 *a*. Borer for holes of $\frac{7}{16}$ inch in diameter, 5s.

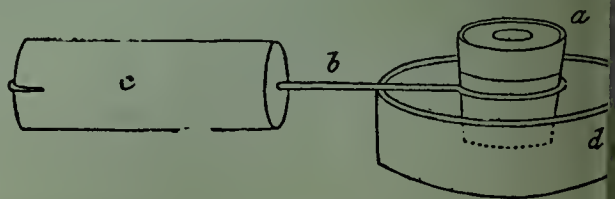
4304 *b*. Borer for holes of $\frac{1}{16}$ inch in diameter, 2s.

4304 *c*. Borer for holes of $\frac{1}{4}$ inch in diameter, with spatula end, 2s.

DESCRIPTION OF PASTILLE CHARCOAL SUPPORTS FOR BLOWPIPE EXPERIMENTS. By JOHN J. GRIFFIN. Reprinted from the "Proceedings of the Philosophical Society of Glasgow," 26th April, 1843.

4305. Several of the most important experiments performed with the Blowpipe require assistance of charcoal, upon which the object submitted to examination is supported in the flame. The charcoal employed for this purpose should be of soft wood, well burnt, compact, and free from crevices. Such charcoal is difficult to obtain. I have several times examined a sackful of charcoal without finding above half-a-dozen sticks adapted for these experiments. This circumstance induced me to seek for a substitute, and having found one which seems likely to prove serviceable, I think it possible that other persons accustomed to operate with the Blowpipe, and accustomed also to the want of suitable charcoal, may be willing to learn in what manner they can easily replace it by an efficient substitute. For this reason I have drawn up the following notice.

4306. The Blowpipe experiments that require the assistance of charcoal may be divided into two classes:—In the first class may be named, the formation of beads with microcosmic salt, the trial of fusibility *per se*, and the roasting of the metallic compounds that contain such volatile elements as sulphur and arsenic. The second class of experiments is restricted to the fusion of minerals or metallic compounds with carbonate of soda, or with soda and borax, for the purpose of effecting



4306.

rticular combinations or of procuring their metals in the state of regulus. For these two uses of experiments, I make use of two different composition supports, the first of which shall call *Supports for Fusions*, and the second *Supports for Reductions*. These are alike in appearance—the form and size of both being shown by Fig. 4306 a. Each consists of two parts, upper or combustible portion, and a base or incombustible portion. The former is the proper substitute for the ordinary charcoal, the under portion only acting as a crucible in which the incombustible portion is contained. I shall first describe the composition and formation of the supports, and afterwards show the way to use them.

4307. The incombustible portion of both supports is made of fine pipe clay and charcoal powder, mixed in equal parts by weight, with as much water, slightly thickened by rice paste, as is sufficient to form a stiff plastic mass.

The combustible portion of the *Support for Fusions* consists of—

Charcoal in fine Powder	...	...	...	12	Parts.
Rice Flour	...	...	...	$\frac{1}{2}$	„
Water	...	...	...	about 8	„

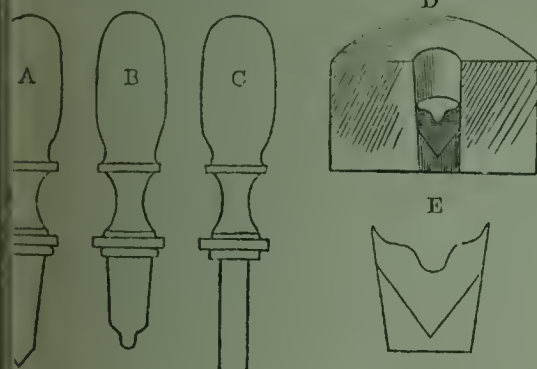
The rice is boiled in the water to form a paste, with which the charcoal is afterwards mixed into a mass of the consistence of dough.

4307 a. The upper part of the *Support for Reductions* consists of the following mixture:—

Charcoal in fine Powder	...	...	...	9	Parts.
Carbonate of Soda, crystallized	...	...	...	2	„
Borax, crystallized	...	...	...	1	„
Rice Flour	...	...	...	$\frac{1}{2}$	„
Water	...	...	...	about 8	„

The water is boiled, the soda and borax are dissolved in it, and the rice is then added to form a paste, with which the charcoal is finally incorporated, and the whole well kneaded into a stiff mass.

4308. The mould in which these compositions are pressed to form the supports, is made of box-wood, and consists of four pieces, represented by Fig. 4308, A, B, C, D.



4308.

D is a cylindrical block, having a conical hole through the centre; A, B, C, are pestles or stampers fitted to this hole. The mould, D, when in use, is set upon a clean surface of iron, such as a Blowpipe anvil. A round ball of the clay composition, $\frac{1}{4}$ inch in diameter, is put into it, and pressed to the bottom by means of the pestle A. This forms a conical cup or crucible similar to the under portion of Fig. E, which represents a vertical section of a support. A round ball of the combustible composition, of either kind, $\frac{1}{2}$ inch in diameter, is next put into the mould, and pressed firmly down with the pestle B, and the pestle, before being withdrawn, is gently turned round to smooth the surface of the support. The

mould is now lifted from the anvil, and the pestle C is applied below to push the support out of the

The principal points which require attention, to ensure success in this process, are, to have the materials in the state of very fine powder, and the moist compositions of a proper degree of consistency. If they are too soft, the support will not quit the mould without losing its form. If too hard, the particles of the support will not cohere. The proper state is found after a few trials. It is most convenient to begin by making the mixture too soft, and then drying it slowly till found to be hard enough to work easily. The composition is rolled into little balls of the size before mentioned by means of the fingers. The moulds should be kept clean, and the forming parts of the pestle B and the ring D should be oiled. The best way to clean the hole in the mould D is by means of a conical cork, rasped to a rough surface and oiled. The point of the pestle A must not be oiled, as grease prevents the adhesion of the combustible portion of the support to its clay base.

When the support is taken from the mould it is put on a hot plate or a sand bath to dry, after which the rough edges are taken off by a rasp. It is then ready for use. The bottoms of the supports for reductions are painted with red ochre mixed with rice paste, to distinguish them from other kind. The size I have fixed upon is as follows:—Height $\frac{1}{2}$ inch, diameter at the top $\frac{1}{4}$ inch, at the bottom $\frac{3}{8}$ inch. The weight is about 16 grains, consisting of 10 grains of clay crucible, 6 grains of combustible matter. I have tried several other sizes, but find this to be the most generally convenient. Nevertheless, a higher temperature can be produced upon a smaller support, and I find that large masses of charcoal are not essential, since many blowpipe experiments can be held during the combustion of only two grains of charcoal.

4309. Before I proceed to explain the mode of using these supports, I must describe the handle by means of which they are to be held in the blowpipe flame. This handle consists of an iron wire,

$3\frac{1}{2}$ inches long and $\frac{1}{50}$ inch in diameter, one end of which is bent into a ring about $\frac{2}{3}$ inch in diameter while an inch of the other end is forced through a round cork 1 inch long and $\frac{1}{5}$ inch in diameter represented by *b, c*, Fig. 4306. The operator fixes the support in the ring of this wire, and holds by the cork handle, which is intended, not so much to protect the fingers from heat, as to protect the power of varying the position of the support in the flame, as the progress of an ignition requires.

4310. I shall now describe one or two experiments which show the method of using these supports.

(1). The surface of one of the *Supports for Fusions* is heated before the blowpipe till it is red. If then removed from the blowpipe flame, the support continues to burn, like an ordinary pastille till it is consumed down to the clay. In this respect, the support has a superiority over ordinary charcoal, which soon ceases to burn when removed from the fire. The ignited support is to be received on a porcelain capsule in the manner represented by Fig. 4306 *d*, and a quantity of microcosmic salt sufficient to form a bead, is placed upon its red hot surface. The salt instantly melts and sinks into the central cavity, so as to form a bead, Fig. 4310 *F*; the heat, the form, and the smoothness of the surface of the support, facilitating this part of the process. The salt is then heated before the blowpipe till it is melted into a transparent colourless bead. The support is again placed on the porcelain capsule, and the metallic substance intended to be incorporated in the bead is added to it. The support continuing to be red hot, and the bead consequently continuing soft, the substance so added is immediately absorbed and its loss by dispersion prevented. Whereas, upon common charcoal the fused salt solidifies soon after it is removed from the flame, and the substance added for examination, not adhering to it, is often blown away by the first blast from the blowpipe jet. The support is now again fused till the substance added to it is decomposed, and the resulting glass is observed to fuse quietly. It is then ready for examination, but it is sunk in the bottom of the hollow in the support (see Fig. *F*), and cannot be seen by transmitted light unless the projecting sides of the support be removed. This is effected as follows; the support is placed as before upon the porcelain capsule and the operator blows with his mouth, without using the blowpipe, strongly down upon its surface. The pastille then burns away rapidly, and the force of the blast of air disperses the ash until the whole rim of the support is consumed, down to the part marked in Fig. *F*, with dotted lines. The bead then appears situated on the summit of a cone, as shown in Fig. *G*, and can be examined either by reflected or transmitted light. It is also in a position adapted for exposure to the different action of the oxidating and reducing flames, so as to have the character of the included metal fully developed. If, finally, the charcoal support is allowed to burn wholly away, the coloured bead can be lifted from the ash



4310.

and preserved in a closed glass tube for subsequent examination and comparison.

(2). If the surface of one of the *Supports for Reductions* is heated before the blowpipe, it burns first like the simple charcoal support, but in proportion as the charcoal is consumed, the fluxes which were mixed with it, and which are not volatile, concentrate and fuse upon the surface of the residue. If, therefore, a reducible metallic compound is heated upon such a support, it becomes exposed once to the reducing action of the high temperature, of the nascent oxide of carbon, and of the carbonate of soda, whilst any earthy matter that it may contain is vitrified by the attendant borax. It is easy, therefore, to conceive that these supports should possess a powerful reducing action, so in fact they do. For example, a crystal of sulphate of copper, as large as the surface of a support can be decomposed upon it, and all its elements be driven off except the copper, which is finally obtained in a single metallic bead. A globule of metallic tin, an eighth of an inch in diameter, may be kept boiling upon a support without being converted into oxide. A crystal of quartz can be fused into soda glass. Flint glass can be melted with metallic oxides, in such quantities as to form beads of enamel or coloured glass the sixth of an inch in diameter. And these effects are produced upon a support of the weight of only 16 grains, and during the combustion of perhaps not more than 3 or 4 grains of charcoal. Indeed, many striking results are produced by a combustion of only 2 grains of charcoal, but then this combustion is effected under very favourable circumstances where very little more charcoal is heated than is intended to be burnt, and where no more is burnt than is required to produce the intended effect.

This power of restricting the consumption of charcoal in such experiments, is a merit which will render these composition supports acceptable to travelling mineralogists. Berzelius laments the difficulty of procuring good charcoal when travelling, even in the well-wooded regions of the north, and this difficulty, and the consequent necessity of carrying about a quantity of charcoal, all travelling analysts must find an annoyance. But as the supports which I have described require for each only a cube of $\frac{1}{4}$ of an inch of charcoal, it follows that a sufficiency of this mixture for no less than 500 experiments, may be carried in a square tin box measuring two inches on each side. Moreover, the incombustible portion of the supports can be poured down and remoulded any number of times, so that only a very small quantity of clay is requisite.

(3). The last blowpipe experiment to which I shall now allude is cupellation, the performance of which, before the blowpipe, is considerably facilitated by the apparatus described in this note. When a cupellation is to be effected, a clay crucible is made in the mould *D*, by means of

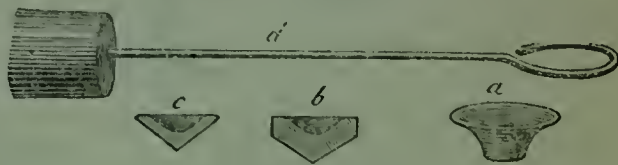
the A, in the manner already described, and into this crucible a quantity of moistened bone is pressed by the pestle B, so as to make a cupel similar in form to a charcoal support, Fig. E, consisting of bone ashes. This cupel being mounted upon the wire handle, shown by Figs. *b, c*, ready for use. A much higher temperature can be raised upon such a cupel than upon the same quantity of bone ashes placed, as usual, in a hole cut in a large piece of common charcoal. I have now only to state my reasons for choosing rice as an ingredient of these pastille supports. They are, that rice paste is a strong, cheap, and convenient agglutinant; that when heated before the blowpipe it melts and binds the charcoal powder well together; that when decomposed, its residue is very difficult of incineration; and that its ashes are neither more abundant nor more troublesome than those of the wood charcoal that forms the mass of the support. These properties enable us to give to charcoal powder any desirable form, and to bind it firmly together, without the admixture of any impurity. Other agglutinants do not possess the same combination of good properties. Thus, gum arabic is sixteen times as dear, it intumesces under ignition so much as to disrupt the charcoal pastille, and its ashes shine at a high temperature with such intense brilliancy, as to dazzle the eyes of the operator, and make analytical observations impossible. It is probable that Rice would form an excellent ingredient in the mixture for Charcoal Electric Batteries.

PRICES OF MOULDS AND MATERIALS FOR GRIFFIN'S PASTILLE SUPPORTS.

1. Griffin's Mould for making charcoal pastille supports for blowpipe experiments, consisting of a ring and three pestles or stampers, all of polished boxwood, in a box, Fig. 4308, A B C D, 2s. 6d.
2. Griffin's Charcoal Pastille Supports for blowpipe experiments, for use instead of ordinary charcoal, *two sorts*:—
3. Supports for fusions, roastings, and for beads of microcosmic salt, size and form of Fig. 4308 E, *per box of 2 dozen*, 6d.
4. Supports for Reducing Operations, on which reguline metals can be extracted from their salts without the use of additional fluxes, *per box of 2 dozen*, 6d.
5. Handles for mounting the support, Fig. 4306 *b c*, 4 for 4d.
6. Porcelain capsules, for use with the supports, Fig. 4306, *d*, 4 for 6d.
7. Japanned Tin Box, containing prepared clay, prepared charcoal, and prepared reducing mixture, sufficient for 1000 supports, 8 cubic inches of each, 3s.
8. Box containing the set of Moulds, 4 dozen of Supports, 4 Handles, 4 Capsules, Box of Prepared Materials for 1000 Supports, with printed instructions for making and using the supports, complete, 8s.

MORE PORTABLE FORM OF GRIFFIN'S PASTILLES.

19. After the publication of the paper of April, 1843, quoted above, I prepared a still smaller form of charcoal support, which I found to answer very well, and which is extremely portable, and frequently useful to the travelling mineralogist. These are represented in Fig. 4319, where *c* and *b* are sections of pastilles, differing in thickness, but made in the same mould; *a* a Berlin porcelain crucible, represented in the same size, by which the pastilles are supported before the blowpipe flame, and *d* is a wire support for the crucible, resembling that described at Fig. 4306, and 4315. These small charcoal supports *b* and *c* are quite sufficient for most qualitative blowpipe experiments.



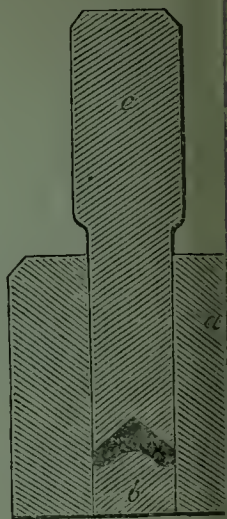
4319.

1. Berlin Porcelain Crucible for supporting pastilles before the blowpipe, form and size of Fig. 4319 *a*, 3d.
2. Pastilles of the size and form of Fig. 4319 *b c*, containing charcoal and rice, but no fluxes, *three dozen in a box*, 6d.
3. Wire support for the pastille crucible, Fig. 4319 *d*, same as No. 4315, four for 4d.
4. Iron Mould for preparing the Pastilles, Fig. 4321 *b c*, form and size of Fig. 4322, page 364, in 3 pieces, polished metal, price 3s. 6d.

The mould consists of three pieces; a cylinder *a*, a piece to form the surface of the pastille *b*, pestle which forms the under side of the pastille *c*. The pastille is formed in the cavity *d*, the thickness of it (producing the difference shown by *b* and *c*, Fig. 4319,) depends upon the size of the ball of plastic charcoal that is put into the mould. The plastic charcoal is prepared by the method described at 4307. Plattner's improvements, as described in 4323, can be adopted when it is considered advisable.

4322 *a*. USE OF FLUXES WITH THE SMALL PASTILLES.—It is easy to saturate the small pastilles heated in the porcelain crucible, 4319*a*, with soda, borax, cyanide of potassium, or any other flux to the action of which it is desirable to submit an assay; and after the fusion, the crucible can, when requisite, be transferred to a test tube, or a capsule, to be treated with acids.

4322 *b*. CHARCOAL BLOCKS FOR SUBLIMATIONS.—As the small charcoal pastilles, Nos. 4310 and 4319, become red hot all over, they afford no cold surface for the deposition of sublimates. For that reason, Plattner prepares with a mould prismatic blocks of charcoal, measuring 3 inches long, $\frac{1}{4}$ th inch wide and $\frac{3}{8}$ th to $\frac{1}{2}$ th inch thick. I find, however, that it is much more convenient, and necessarily much more economical, to collect sublimates upon the clay support, No. 4349.



4322.

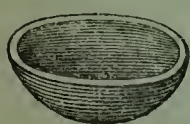
PLATTNER'S ADOPTION AND MODIFICATION OF THE PASTILLE CHARCOAL SUPPORTS.

4323. In the third edition of his work on the Blowpipe, published in Leipzig in 1853, Plattner referred to the above proposal to replace thick charcoal by pastilles, and adopted it with the following modifications:—

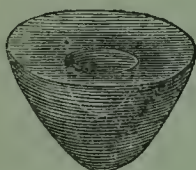
1. He uses starch instead of ground rice, chiefly because he could more easily procure it.—2. purifies the charcoal powder from metals by digestion in hydrochloric acid, and subsequent washing with water and drying it.—3. He makes the pastilles in various forms, in capsules, square blocks, &c., according to the uses to which he intends to apply them. His modifications for these purposes will be described in this work.—4. He puts the dried pastilles into a porcelain crucible and ignites them before use, to deprive them of the power of burning with flame.

4324. Plattner's Mould for making charcoal capsules, to be used for the roasting of metallic ores in blowpipe assays, consisting of a pestle, Fig. 4324, a mould similar to No. 4340, made of polished boxwood, *the pair*, 2s.

4325. Plattner's Charcoal Capsules, form and size of Fig. 4325, per dozen, 1s.



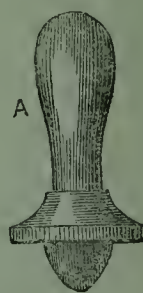
4325.



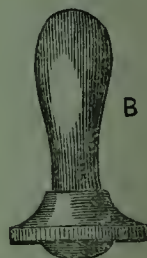
4326.



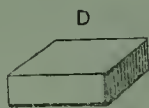
4324.



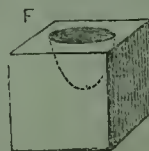
A



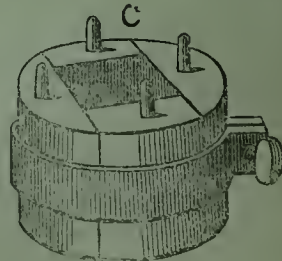
B



D



F



4327.



E



C

For an account of the use of the various capsules and crucibles, formed of charcoal or clay, as recommended by Plattner, I must refer the reader to the last edition of his work, *Die Probirkunst mit dem Löthrohre*. Dritte Auflage. Leipzig, 1853. The English translation of this work is much abridged in what relates to this matter.

4326. Plattner's Charcoal Crucibles for quantitative blowpipe assays, form and size of Fig. 4326, per dozen, 1s.

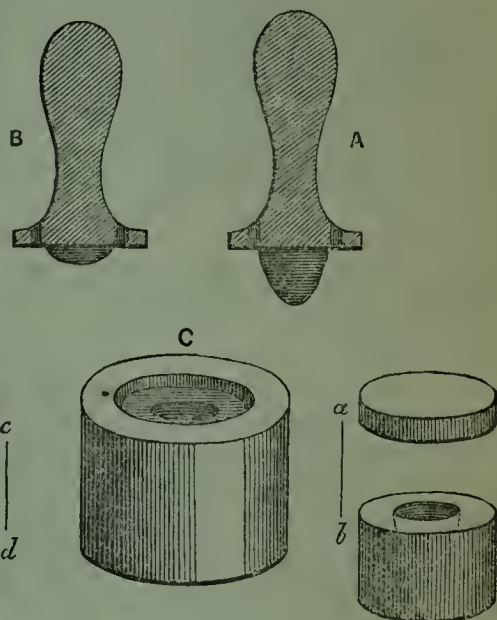
Plattner's Mould for making these charcoal crucibles consists of the mould for making crucibles with an additional pestle. See No. 4343.

327. Plattner's Mould for preparing square blocks of charcoal, for use in roasting metallic ores, and in various fusions of mixtures in the quantitative analysis of metallic ores before the blowpipe; the mould is made of boxwood, Fig. 4327, A, B, C, D, E. The set of 5 pieces complete, with brass binding, 10s. 6d.

Letter c represents the mould which is to form the square block of charcoal. The blocks d and e serve to regulate the thickness of the square block. The pestle A is used to form the hollow of the crucible F. The pestle B forms the hollow of the crucible cover G. The four pegs in the mould c serve to guide the pestle exactly into the middle of the block.

The screwing up and unscrewing of the mould c, Fig. 4327, in the making of every pastille, takes up much time. For which reason, I have made a mould which makes round instead of square blocks for the same purposes.

328. Mould for making Cylindrical Blocks of Charcoal with crucible cavity in them, consisting of the five pieces represented by Fig. 4328, A, B, C, D, E, which are to be used in the manner described by Plattner, *price of the set*, 7s.



4328.

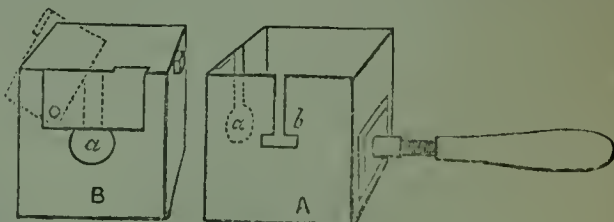
The figures b and d represent a crucible and its cover, corresponding with F and G in Fig. 4327.

329. Plattner's Square Charcoal Blocks with cavity of crucible shape, and corresponding charcoal covers, as made with the mould, No. 4327. Per dozen pair, 4s.

- 329a. Japanned Metal Case, square form, size $5\frac{1}{2}$ inches by $1\frac{3}{8}$ inch, with pull-off cover, for holding 3 pairs of the square charcoals, No. 4329, 1s. 6d.

330. Plattner's Roasting Furnace for holding and exposing to the blowpipe flame the charcoal crucibles, No. 4329, as described in Plattner's Instructions for the Quantitative Analysis of Metallic Ores before the Blowpipe, Fig. 4330, 6s.

331. Round Form of Plattner's Roasting Furnace, used for exposing to the Blowpipe flame the round blocks of charcoal made by the apparatus, No. 4328, with a support for holding it steadily against the blast-gas blowpipe, No. 4252, when the flame is blown horizontally, 6s.



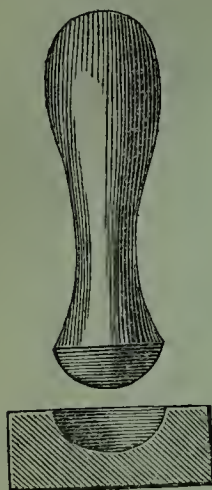
4430.

33. Platinum Wire and Foil, as used with the charcoal holder, No. 4330 or 4331, when an ore is to be roasted, *the pair*, 2s.

34. Charcoal, in fine powder, for preparing charcoal pastilles with the moulds described above, per lb., 6d.

3. CLAY SUPPORTS.

4340. Plattner's Mould for making capsules of porcelain clay, consisting of a mould and a pestle, Fig. 4340, of polished boxwood, *the pair*, 2s.



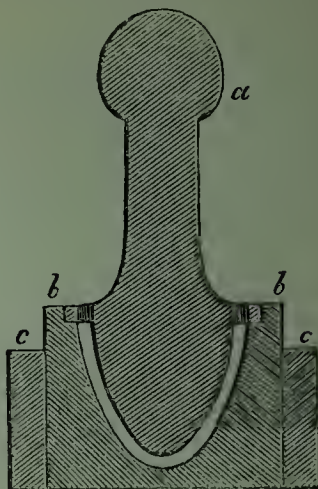
4340.



4342.



4343a.



4343.

4341. Ditto, with the addition of a boxwood pestle, Fig. 4324, for use with the mould in making capsules of charcoal, as explained at 4324, *the three pieces*, 3s.

Fig. 4342 represents the full size of the clay capsule formed in this mould, and Fig. 4325 shows the charcoal capsule which it produces.

4342. Plattner's Capsules of porcelain clay, burnt ready for use, form and size of Fig. 4342, per dozen, 1s.

4343. Plattner's Mould for making small crucibles of porcelain clay, No. 4344, and of charcoal, Fig. 4326, which figure is of the actual size. The mould for making the clay crucibles is represented by Fig. 4343. It is made of gun metal, in four pieces. The stamper for forming the middle part of the charcoal crucible, Fig. 4326, is represented of a reduced size by Fig. 4343a. It is made of boxwood. *Price of the Set*, 10s.

Full instructions for making these clay capsules and crucibles are given in Plattner's work. The clay being made of a proper consistence, is rolled into small balls and put into the moulds, which are previously cleaned and oiled. They are then pressed into shape by the pestles, carefully removed from the moulds, dried, and afterwards heated to redness in a closed crucible.

4344. Plattner's Crucibles of porcelain clay, the form and size shown by the whole space in the Fig. of the mould, No. 4343, burnt, ready for use, *per dozen*.

4345. Japanned Metal Cylindrical Case for holding a supply of the crucibles, No. 4344, and the capsules, No. 4342, size, $3\frac{1}{2}$ inches by 1 inch, 1s.

4348 Prepared Porcelain Clay, for making the crucibles, No. 4344, and the capsules, No. 4342, the mass requiring only to be mixed up and well kneaded with water to be ready for use, *per lb.*, 6d.

4349. SUPPORT FOR GRIFFIN'S BLOWPIPE PASTILLES, TO BE USED WHEN SUBLIMATES ARE TO BE OBSERVED, made of smooth pottery, not glazed, form of Fig. 4349, size, 3 inches long, and 2 inches wide, price 1s.



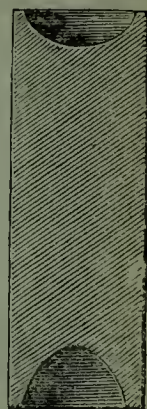
4349.

4350. The charcoal pastilles, Nos. 4310 and 4319, when once ignited, exhibit a red heat over the whole surface, and afford no cool place upon which a volatilised powder or sublimate can be deposited. But since, in many blowpipe operations, it is requisite to note the colour, volatility, and other properties of sublimates, it is necessary to provide for their deposition upon some other surface than that of the red hot pastilles. Plattner uses a sufficiently large block of charcoal, or a very large pastille, as I have noticed at No. 4322 b. But I prefer for this purpose a smooth surface of fire-clay,

of the form and size just described. I invert this mass of fireclay over and into a smoky flame, until it is covered evenly with a coat of charcoal. I then cool the fireclay and I put a charcoal pastille, Fig. 4319 *b* or *c*, into the hole *a* at one end of the support, Fig. 4349, and I perform the necessary blowpipe ignition, taking care to direct the blast of air upon the assay placed in the hole *a* in the direction *a* to *b*, Fig. 4349. The sublimate that is produced by the heat is thereby made to fall on the blackened surface of the support, and whether it is white, blue, red, or brown, it is distinctly visible; and as, moreover, there is plenty of room for the sublimate to deposit itself fully, the form, size, and range of the sublimate, and its gradations of colour are much better seen than it ever is on a small and rough surface of either stick or pastille charcoal.

After each operation the surface of the support is rubbed clean with rough paper, or with sand paper, to be ready for a fresh experiment.

If the charcoal pastille does not fit well in the hole *a*, it can be kept in place by a little stiff rice paste rubbed between the hole and the pastille.



4351.

351. Fireclay Support for holding $\frac{3}{4}$ inch capsules and crucibles, either of charcoal or fireclay, before the Blowpipe, consisting of a cylinder of fireclay, form of Fig. 4351, 3 inches long, 1 inch diameter, bored to hold a capsule (No. 4325 or 4342) at one end, and a crucible (No. 4326 or 4344) at the other end, 6d.

This support can also be used for cupellation with bone ash pressed into one of the holes, by the pestle of the agate mortar.

4. GLASS SUPPORTS.

60. Narrow Tubes of hard Bohemian glass, free from reducible metals, used for heating or subliming substances in a current of atmospheric air, from $\frac{1}{16}$ th to $\frac{3}{16}$ th inch in diameter, cut into pieces of 6 inches in length, *per dozen*, 6d.

62. Narrow Tubes of hard Bohemian glass, about $\frac{1}{4}$ inch or $\frac{1}{3}$ inch in diameter, made extremely thin in the glass, in order that sublimates within them may be brought into the focus of lenses of high magnifying power, to make it possible to determine the crystalline forms of the sublimates. Cut into 6 inch lengths, *per dozen*, 9d.

63. PLAIN TUBES OF HARD WHITE GERMAN GLASS, closed at one end, Fig. 4363.



4363.

PRICES PER DOZEN :—

LENGTH in INCHES.	DIAMETER across the middle in INCHES.			
	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{3}{8}$
1 inch	3d.	3d.	4d.	4d.
1½ "	3d.	3d.	4d.	4d.
2 "	3d.	3d.	4d.	4d.
2½ "	4d.	4d.	4d.	5d.
3 "	4d.	4d.	4d.	5d.
4 "	4d.	4d.	6d.	7d.

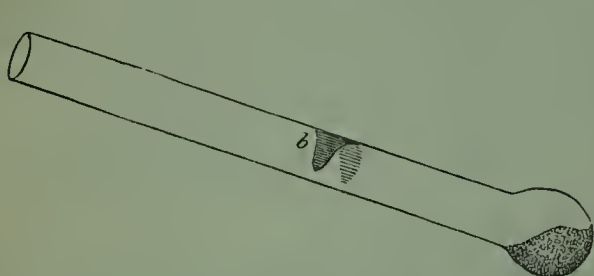
For the price of **LARGE TEST TUBES** for use with liquids, in boiling, testing, see article on **TESTING**, page 269.

4364. Brush for cleaning narrow Test Tubes, Fig. 158, 2d.

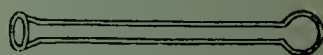
4365. Berzelius's Bulb Tube for trying the hydration of minerals before the blowpipe, oval bulb, $\frac{5}{8}$ by $\frac{3}{4}$ inch, tube $1\frac{1}{2}$ by $\frac{1}{4}$ inch hard Bohemian glass, Fig. 4365, per dozen, 1s. 6d.

4366. Support for Bulb Tubes when hot, Fig. 387, 6d.

ARSENIC TUBES, for the reduction of Arsenical Compounds and sublimation of Arsenic. all made of hard German or Bohemian Glass, free from reducible metals.



4370.



4367a.



4367b.

4367. Bulb Tubes, for subliming Arsenic, Figs. 4367 *a* and *b*, 1, $1\frac{1}{2}$, and 2 inches long, by $\frac{1}{6}$ or $\frac{1}{8}$ inch wide in the tube, bulb $\frac{1}{4}$ inch, per dozen, 4d.

4368. Bulb Tubes, bulb $\frac{3}{8}$ to $\frac{1}{2}$ inch, tube $2\frac{1}{2}$ inches long, $\frac{1}{8}$ inch wide, per dozen,

4369. Ditto Bulb, $\frac{3}{8}$ to $\frac{1}{2}$ inch, tube $2\frac{3}{4}$ inches long, $\frac{1}{4}$ inch wide, per dozen, 10d.

4370. Berzelius's Bulb Tube, for use when the mixture to be heated is bulky, of Fig. 4370, hard Bohemian glass, per dozen, 1s.

4371. Berzelius's Arsenic Tube, size of Fig. 4371, 3 inch, per dozen, 1s.

4372. Ditto, 6 inches long, per dozen, 3s.

4373. Rose's Arsenic Tube, size of Fig. 4373, 3 inch, per dozen, 1s.

4374. Ditto, 6 inches long, per dozen, 3s.

4375. Liebig's Arsenic Tube, 3 inch, size of Fig. 4375, per dozen, 1s.

4376. Box containing an assortment of 15 Arsenic Tubes of different kinds, 1s.



4371.



4373.

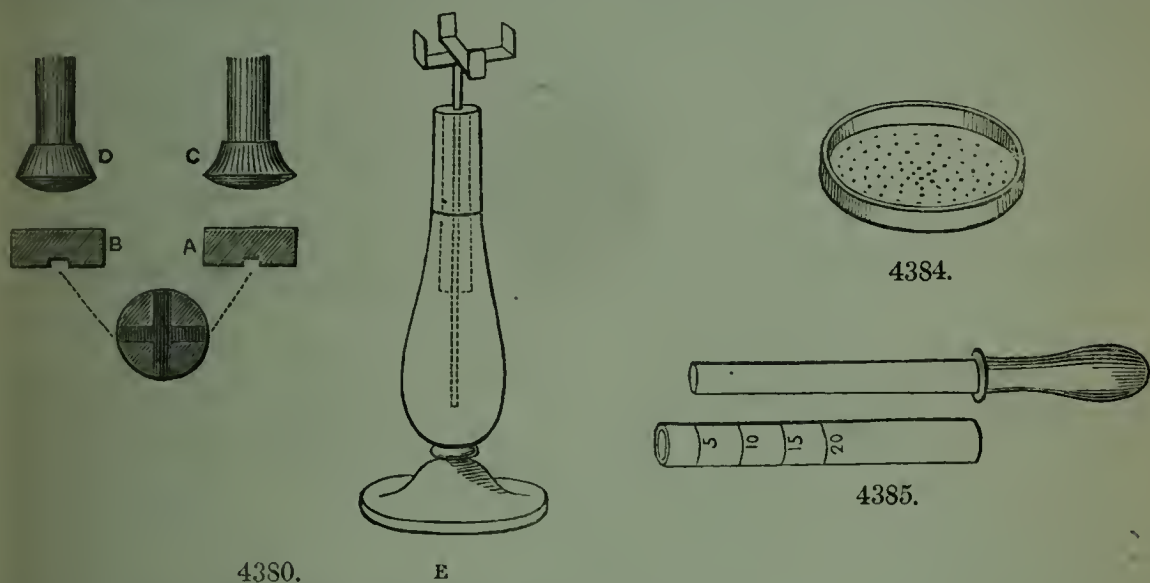


4375.

CUPELLATION BEFORE THE BLOWPIPE.

80. Plattner's Apparatus for Cupellation before the Blowpipe, represented by Fig. 4380, consisting of two cupel moulds, A and B, with corresponding dies or pestles C and D, and a support E. The moulds A B differ in size. The cupels are exposed to the flame upon the moulds.
- 80 a. Price when the moulds and pestles are made of hardened polished steel, 10s. 6d.
- 80 b. Price when they are made of iron, 7s.

Plattner's work contains minute instructions for performing the operation of cupellation before the Blowpipe. Cupellation can be performed on cupels made in the manner described at No. 4310, 3, so upon a cupel made in the mould, No. 4322, or upon a cupel pressed in the cavity of the fire-cylinder, No. 4351.



81. Bone Ash for preparing cupels, *per lb.*, 6d.
82. Pure Lead, finely granulated, for cupellation, *per lb.*, 1s. 3d.
84. Plattner's Brass Sieve, to prepare fine-grained lead, for cupellations before the blowpipe, 1s. 9d.
85. Plattner's Measure for lead, for use in cupellation, consisting of a graduated glass tube, and a pestle of boxwood, which slides in the tube, and can be adjusted to any required measure, 2s.
86. Plattner's Balance and Weights, for weighing small quantities of materials for quantitative analysis before the Blowpipe, or for weighing small beads of gold, silver, copper, and other metals, £4.

See description at No. 435.

87. Plattner's Balance, very highly finished, electro-gilt, with various additions to the weighing apparatus, £6.
88. Folding Glass Case, to contain the balance, No. 4387, when in use, and folding up into a small space for travelling, polished mahogany, 40s.
89. Plattner's Ivory Scale, for measuring the very small beads of gold and silver, obtained by cupellation before the Blowpipe, 15s.

TOOLS AND MISCELLANEOUS INSTRUMENTS FOR USE IN BLOWPIPE EXPERIMENTS.

4395. HAMMER for Blowpipe Experiments, square face, and one cutting edge, 1 steel, with handle, see page 1. 1s. 6d.

4396. Hammer, very highly polished, 2s. 6d.

4397. ANVIL for Blowpipe Experiments, square block of hardened steel, $1\frac{1}{2}$ inch square, block $\frac{5}{8}$ inch thick, polished on one face, 1s. 6d.

For other sizes of Anvils, see page 2.

4398. Anvil, steel, size $1\frac{1}{2}$ inch long, $1\frac{1}{4}$ inch wide, $\frac{3}{8}$ inch thick, very highly polished on all its faces, 2s. 6d.

4399. Steel Mortar for Crushing hard Minerals, small size, Fig. 4399, 6s.

For several other varieties, see page 5.



4400. Agate Mortar and Pestle, for Experiments of Reduction before the Blowpipe, *a*, $1\frac{3}{4}$ inch diameter, 5s. 6d.;—*b*, 2 inch, 7s.;—*c*, $2\frac{1}{4}$ inch, 8s. 6d.

For particulars and Prices of other Sizes, see page 6.

4401. Glazed Porcelain Mortar for Blowpipe operations. See No. 56, page 6, 6s.

Intended as a substitute for an agate mortar, in experiments of Reduction. It can be used in many experiments, but is by no means so useful as the agate mortar.

4402. Plattner's Mixing Capsule, Fig. 4402, for mixing powders, and transferring the mixture to a paper crucible, No. 4440, size $2\frac{1}{2}$ inch by 1 inch, made of thin polished brass, 6d.

4403. Ditto, ditto, polished horn, 1s.

4404. Spatula, 4 inches long, $\frac{1}{8}$ inch wide, form of Fig. 4404, burnished steel, 1s.

4405. Camel-hair Brush, to assist in transferring fine powders from vessels to a vessel, that no part be lost, 2d.

4406. Ivory Spoon, Fig. 4406, with spatula handle, 3 inches long, bowl $\frac{1}{4}$ inch diameter, 1s.

4407. Platinum Spatula, Fig. 4407. See page 10 for varieties of size and price.

4408. Steel Spatula, with coco handle, Fig. 4408. For prices and sizes, see page 10.

4409. Test Spoon of polished German silver, with a bowl $\frac{1}{4}$ inch diameter, for lifting small quantities of powder, the handle fashioned into a spatula for mixing powders, &c., in blowpipe and other experiments, $3\frac{1}{2}$ inches long 3s.

TONGS FOR USE IN BLOWPIPE OPERATIONS.

10. Brass Tongs, for trimming the blowpipe lamp, Fig. 4410, *a, b, c*, each 2d.
11. Iron Tongs, 4½ inch, Fig. 4411, 1s.
12. Fine Brass Tongs, Fig. 4412, highly polished, 3s.
13. Fine Spring Steel Tongs, Fig. 4413, 3s.



4410 *a*.



4413.



4412.



4411.



4410 *c*.



4414.



4410 *b*.



4416.

14. Iron Tongs, with spoon handle for fluxes, Fig. 4414, 9d.
- 14 *a*. The same, without the spoon, 6d.
15. Steel Tongs, similar in form, but better finished, 1s. 6d.
16. Steel Pliers, form of Fig. 4416, black, size 4 inches long, 1s. 6d.
17. Steel Pliers, Fig. 4416, 4½ inches long, highly polished, 2s. 6d.
18. Cutting Pliers, to detach pieces of a mineral for examination, 5½ inch, 3s. 6d.
19. Strong Scissors, for cutting sheet metals, per pair, 1s. 6d.
20. Folding Pocket Knife, 2-inch blade, 1s.

FILES.



4421.

21. Flat File, smooth cut, for trying the hardness of minerals, 4 inches long, 1/8 inch wide, Fig. 4421, 1s.



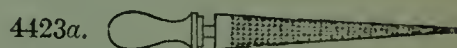
4422.

22. Triangular File, for cutting glass tubes, with handle, 8d.



4423.

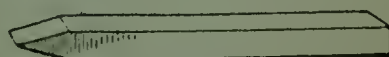
23. Rat's Tail File, for piercing corks, with handle, 4 inch, 8d.



4423 *a*.

- 23 *a*. Flat Rasp, for shaping corks, 4 inch, with handle, 8d.

24. Steel Chisel, 4 inches long and 1/4 inch wide, polished, and strongly magnetised, Fig. 4424, 1s. 6d.

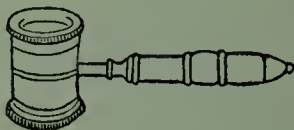


4424.

4425. Streak or Colour of Minerals, a slab of pure white biscuit Dresden porcelain for trying this property, size 4 by 3 inches, 1s.
4426. Ditto, of white biscuit Thuringian porcelain, size 3 by 2 inches, 6d.
4427. Magnetic Needle and Electric Needle, each $1\frac{1}{2}$ inches long, both adapted to the same stand, and fitted into a turned wooden case, Fig. 4427, 7s. 6d.
4428. Ditto, larger; the needles each 3 inches long, and mounted with agate cups, but without case, 8s.
4429. Ditto, the large size, but without agate cups, 5s.
4430. Pair of Small Bar Magnets, 3 inch, with two keepers, in a leather case, with pull-off top, 1s. 6d.
4431. Horse Shoe Magnets, with keeper:—
2 inch, 6d. 4 inch, 1s. 6 inch, 2s.
4432. Brush for cleaning beads of metal, strong bristles, 1s. 6d.
4433. Tin Foil in small rolls, for assisting the operation of Reduction in beads before the Blowpipe, *per dozen rolls*, 4d.
4434. Triple Lens, for examining small crystals, or the products of Blowpipe operations, the lenses $\frac{7}{8}$, $\frac{3}{4}$, $\frac{5}{8}$ inch diameter, in horn mounting, Fig. 4434, 4s.
4435. Magnifier, in tortoise-shell mounting, having at one end 2 plano-convex lenses, $\frac{5}{8}$ inch diameter, separated by a diaphragm, and at the other end a Coddington Lens, 8s. 6d.
4436. Coddington Lens, Fig. 4436, mounted in ivory, 3s. 6d.
4437. Stanhope Lens, Fig. 4437, mounted in ivory, 3s. 6d.
4438. Stanhope Lens, mounted in silver, 7s. 6d.
4439. Magnifying Lens, Fig. 4439, in horn case, 1s.



4427.



4436.



4437.



4434.

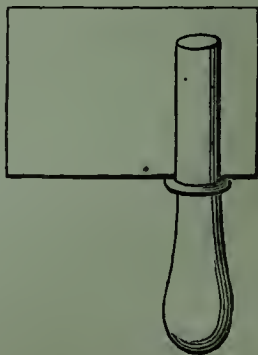


4439.

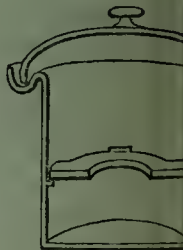
MICRO-CHEMICAL APPARATUS FOR EXPERIMENTS IN THE WET WAY, TO SUPPLEMENT BLOWPIPE OPERATIONS.

APPARATUS FOR DECOMPOSING MINERALS.

4440. PLATTNER'S SODA PAPER, for preparing cartridges, or cases in which mineral powders are to be ignited before the blowpipe, prepared of pure filtering paper and pure carbonate of soda, in pieces measuring 1 inch by $1\frac{1}{2}$ inch, *Box containing 50 pieces*, 4d.
4441. Boxwood Mould, form of Fig. 4441, to assist in rolling the paper into a case, 6d.
4442. This is used in preparing siliceous minerals or metallic ores for solution in acids. The cartridge is prepared by rolling the prepared paper, No. 4440, by means of the pestle, No. 4441, into a cylinder, the end of which is to be closed by folding down the paper with a spatula. Two grains of the mineral or the roasted ore are to be ground in a mortar with a mixture of borax and carbonate of soda. The ground mixture is transferred to the capsule, No. 4402, and is conveyed thence



4441.



4443.

to the paper cartridge: this is then folded up and placed in the cavity of the charcoal crucible, No. 4326, which is placed in the clay support, No. 4351, and exposed to the blowpipe flame. The object of the soda paper is to prevent any of the powder being blown away by the mechanical action of the blowpipe jet. After the fusion of the assay is accomplished, the analysis of the residue is effected by the processes which Plattner's work gives in detail. The gas blowpipe, No. 4252, answers well for fusions of this description.

443. Brunner's Apparatus for Decomposing Siliceous Minerals that contain Alkalies, by means of Hydrofluoric Acid gas. Made of lead, form of Fig. 4443. The cover dips into a lute of plaster of Paris; the crucible containing the mineral that is to be decomposed is fixed on the central perforated shelf; the mixture of fluor spar and oil of vitriol is put into the bottom of the apparatus. Size, 4 inches diameter, 4 inches high, 8s.

VESSELS IN WHICH TO PREPARE SOLUTIONS.

Preceding sections of this work contain abundant particulars of small vessels suitable for preparing solutions for micro-chemical operations. Among others may be cited, the smaller kinds of crucibles and capsules of platinum, pages 136 and 185; porcelain crucibles, page 137; porcelain cups, pages 182 and 193; porcelain basins, page 186; glass flasks, page 146; beakers, page 152; test tubes, page 269; and bulb tubes, page 149. The following kinds will be found useful.

444. Porcelain Hemispherical Cups, Fig. 4444.

a. 1 inch diameter, 3d.

b. 2 inches diameter, 5d.



445. Platinum Basin, Fig. 4445, price, according to weight, from 20s. to 30s.

See prices of platinum vessels at pages 136 and 185.

446. Porcelain Beakers, Fig. 4446, 5 sizes. See No. 1491.

447. Thin Porcelain Cups, various sizes, see p. 193, No. 1801, varieties 7, 8, 9.

448. Plattner's Blowpipe Crucible, see No. 1333, with cover, 6d.

449. Ditto, without cover, 4d.

450. Plattner's Porcelain Digester, Fig. 4450.

a. $2\frac{1}{4}$ inch diameter, $1\frac{1}{4}$ ounce, 7d.

b. $1\frac{3}{4}$ inch diameter, $\frac{1}{2}$ ounce, 6d.



Figures and particulars of other forms and sizes of porcelain vessels are given at pages 192, 193.

451. German Glass Flask, with wide mouth, Fig. 1400, 1 ounce, $1\frac{1}{2}$ d. ; 2 ounce, 2d. ; 3 ounce, $2\frac{1}{2}$ d.

For other varieties and sizes of flasks, see pp. 145—150.

452. Beaker Glasses for Solutions, nest of four, holding from 1 to 5 ounces, Bohemian glass, No. 1461, 1s. 3d.

453. Ditto, nest of three, holding from $\frac{1}{2}$ to $1\frac{1}{2}$ ounces, Bohemian glass, No. 1441, 7d.

For other sizes of Beakers, see pp. 152-3.

454. Watch Glasses, 2 inch, for use as covers to the Porcelain Capsules, &c., per dozen, 1s.

4455. Boiling Tubes of German Glass, No. 1419 :—

a. 4 inches long, 1 inch wide, per dozen, 1s. 2d.

b. 6 inches long, $1\frac{1}{4}$ inch wide, per dozen, 1s. 9d.

4456. Test Tubes, for boiling solutions, 6 inches long, $\frac{3}{4}$ inch wide, set of six, 8d.

4457. Folding Support for the six Test Tubes, 2s.

4458. Nests of German Glass Test Tubes, each nest in a paper box :—

a. Three Tubes	..	6d.		c. Nine Tubes	..	1s. 3d.
----------------	----	-----	--	---------------	----	---------

b. Six Tubes..	..	10d.		d. Twelve Tubes	..	2s.
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4459. Support for holding large Test Tubes over a spirit lamp, brass clip, 10d.

See No. 386 for other varieties of Supports for hot Test Tubes.

TESTING APPARATUS.

4460. Filtering Funnel, $1\frac{1}{2}$ inch diameter, $1\frac{1}{2}$ d.

4461. Ditto 2 inches diameter, 2d.

4462. 100 Circular Filters for each of the two funnels, 9d.

4463. Japanned tinplate box to hold the 200 filters, 6d.

4464. Funnel Holder, Black wood, 1s.

4465. Porcelain Filter Rings with two arms, for supporting the paper filter with funnel or funnel holder, 5d.

4466. Griffin's Quick Filter, see No. 2813, 3d.

4467. Conical Test Glasses, Fig. 2817, small size, 1 inch high, 1 inch wide, on foot set of six, 9d.

4468. Decanting Tube, see No. 2814, three for 6d.

4469. Conical Precipitating Jar, 5 ounce size, Fig. 1487, 8d.

4470. Glass Stirrers, form of

Fig. 4470.

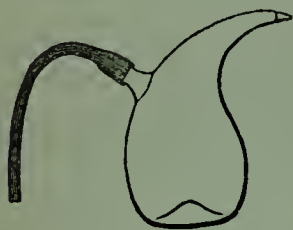
3 inch, per dozen, 2d.

6 inch, per dozen, 4d.

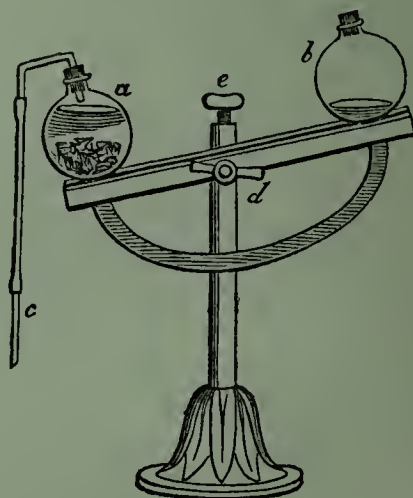
4470.

4471. Small Washing Bottle with two tubes, 8 ounce, see No. 1725, 1s. 6d.

4471a. Washing Bottle with one jet, see No. 1719, 1s.



4472.



4473.

4472. Schuster's Washing Bottle, fitted with a blowing tube, for supplying small quantities of water, or for washing precipitates on a filter, Fig. 4472, 1s

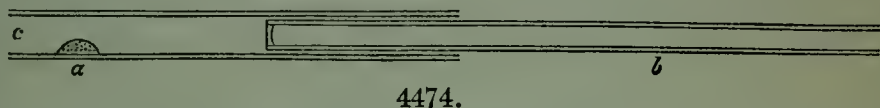
APPARATUS FOR SULPHURETTED HYDROGEN GAS.

473. Von Babo's Sulphuretted Hydrogen Gas Apparatus, for the prompt supply of that gas in small quantities, Fig. 4473, with support, 6s.

The bulb *a* is half filled with lumps of sulphide of iron; the bulb *b* is partly filled with diluted sulphuric acid. These two bulbs and the bar to which they are fixed, revolve on a centre at *d*, and can be fixed by the screw *e* in any required position. When the bulb *a* is placed higher than the bulb *b*, the acid runs into the latter bulb, and its action on the sulphide of iron ceases. When the bulb *a* is placed lower than the bulb *b*, the sulphuric acid flows upon the sulphide of iron in *a*, and continuous current of sulphuretted hydrogen gas passes off by the bent flexible tube and the glass tube *c*. When the apparatus is not in use, the flexible tube *c* should be closed by a pinchcock, and the neck *b* by a cork.

474. Apparatus for Testing with Sulphuretted Hydrogen Gas, where minute quantities of materials are employed, consisting of two glass tubes, size of Fig. 4474, the pair, 5d.

At *a* in the wide tube, put a small quantity of a mixture of one part of sulphide of calcium and three parts of bisulphate of potash. Dip the end of the tube *b* into the liquor that is to be tried for a metal that gives a coloured precipitate with sulphuretted hydrogen gas. Put the tube *b* into the wide tube as represented. Warm the wide tube at *a*, and then blow with the mouth gently into the open end *c*. Thereupon, sulphuretted hydrogen will be disengaged from the mixture *a*, and will produce a coloured precipitate at the inner end of the tube *b*.



4474.

A variety of other forms of Apparatus for use with sulphuretted hydrogen gas are described at pages 220—222.

BOTTLES TO CONTAIN AND APPLY LIQUID TESTS.

Bottles to contain solutions of re-agents, acids, &c., with pipettes, long stoppers, pierced stoppers, and other contrivances for delivering drops or small quantities of re-agents in qualitative analysis.

475. Cobalt or Acid Bottle, of stout glass, with elongated stopper and ground cap, for applying drops of acid, or of solution of nitrate of cobalt, in Blowpipe experiments, Fig. 4475:—

$\frac{1}{2}$ ounce to 1 ounce, 1s.; 2 ounce, 1s. 3d.; 3 ounces, 1s. 6d.

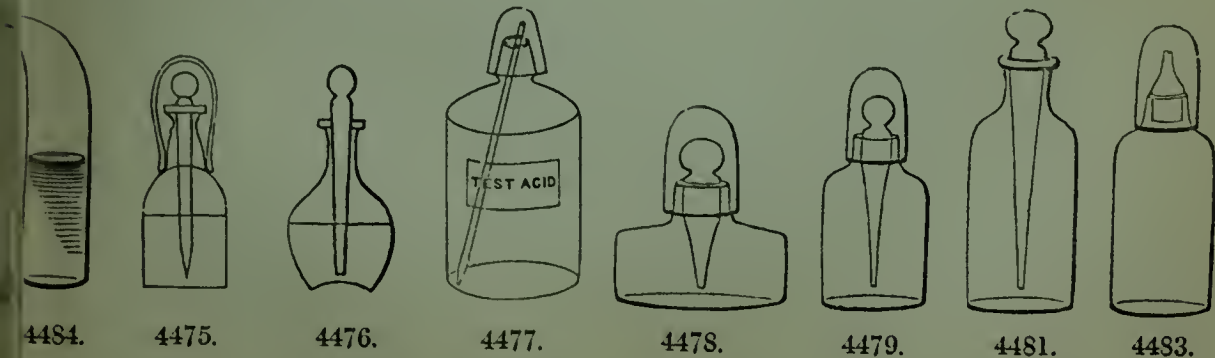
476. Bottle blown before the lamp, with long stopper, Fig. 4476, 1 ounce size, 8d.

477. Bottles with ground caps and pipettes, useful for acids and all re-agents. Many sizes. See No. 1556, page 161.

478. Flat Acid Bottle, with long stopper and ground cap, for drops of acid, 1s.

479. Cylindrical Acid Bottle, about $\frac{1}{2}$ ounce, with long stopper and ground cap, for delivering acid in drops, 1s.

480. The Acid Bottle, No. 4479, fitted into a stout gutta-percha case, which opens stiffly, intended for the pocket of mineralogists in the field, being the safest form of acid bottle.



4484.

4475.

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4481.

4483.

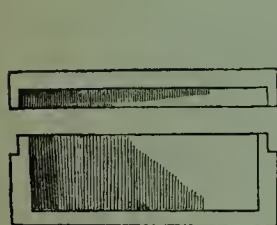
4481. Bottle with long glass stopper, without cap, contents about 1 ounce, 9d.
 4481a. Acid Bottle, for the pocket, for mineralogists to use in the field; cut glass with stopper and cap, $\frac{1}{4}$ ounce, 2s.
 4482. Bottle with stoppered bulb pipette ground into it, by which larger or smaller quantities of test can be delivered as necessary, see Fig. 1651, 9d.
 4483. Bottle about $\frac{1}{2}$ ounce, with ground cap and stopper with fine perforation, by which very small drops of test can be delivered, 1s. 3d.
 4484. Glass Tube Bottle, drawn off to a point, having a fine opening, *each*, 8d. *per dozen*, 2s. 6d.

To be filled by being warmed, and the point dipped into the liquid. The test is expelled in due time when required, by the heat of the hand applied round the bottle.

Other Bottles for Liquid Tests are described in the Sections that commence at pages 272 and 273. Pipettes of all kinds are described at page 177.

BOXES AND BOTTLES TO CONTAIN DRY TESTS.

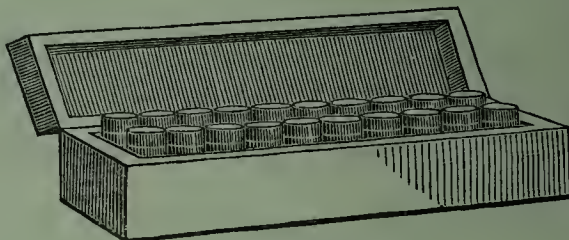
4490. Turned Wooden Boxes, Fig. 4490, with well-fitting slip-on tops, white wood, $1\frac{1}{2}$ inch in diameter, for holding blowpipe re-agents, per dozen, 1s. 6d.



4490.



4491.



4493.



4496.



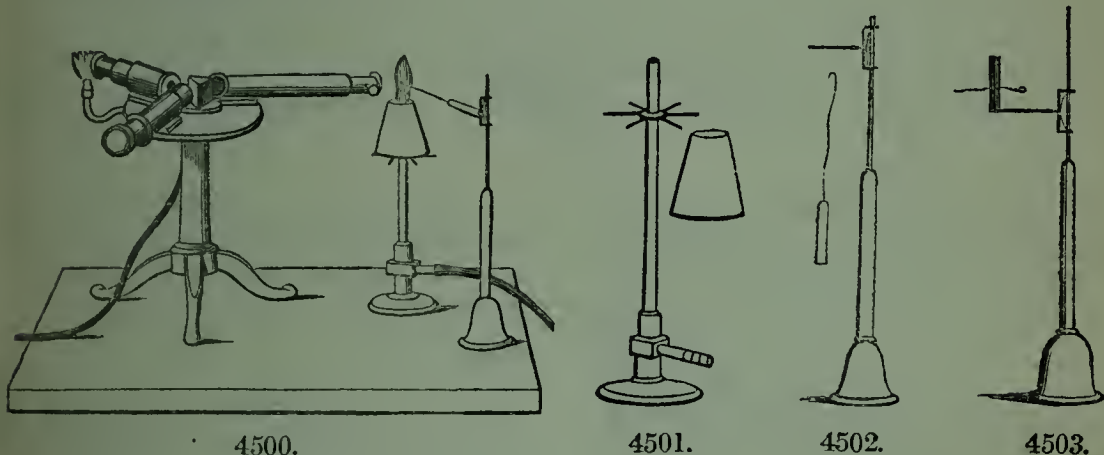
4497.

4491. Turned Wooden Boxes, for Fluxes, form of Fig. 4492, made of boxwood, 1 inch by $\frac{3}{4}$ inch, with screw-on tops, per dozen, 3s.
 4493. Polished Mahogany Cabinet of Stoppered Bottles, for Dry Re-agents, containing 20 wide-mouthed bottles, with ground glass flat-headed stoppers, form of bottles, Fig. 4496; form of box, Fig. 4493; size, $11\frac{1}{4}$ by 2 $\frac{5}{8}$ inches, price 9s.
 4494. The same Cabinet, containing 20 turned polished hard wood boxes, with pull-off tops, form of boxes Fig. 4497, size $1\frac{3}{4}$ by $\frac{7}{8}$ inches, 9s.
 4495. The same Cabinet, containing 10 of the Bottles and 10 of the boxes, 9s.
 4496. Bottles alone, form of Fig. 4496, size $\frac{3}{8}$ ounce of water, 3d. each.
 4497. Boxes alone, polished hard wood, form of Fig. 4497; pull-off tops, fit stiffly; size, $1\frac{3}{4}$ inch by $\frac{7}{8}$ inch; per dozen, 3s.

APPARATUS FOR EXPERIMENTS ON COLOURED FLAMES.

500. KIRCHHOFF AND BUNSEN'S SPECTROSCOPE, or Apparatus for examining the Coloured Spectra produced when the vapours of various chemicals are examined through a Prism. Compendious form of the Apparatus for use in Chemical Laboratories, including an arrangement for the examining of two different spectra at one time, represented by Fig. 4500.

500. Price of the Spectroscope, Fig. 4500, consisting of an Instrument with three tubes mounted on an iron table, with two gas burners like Fig. 4501; one support for objects in the flame, Fig. 4502; another support, Fig. 4503; 8 platinum wires, mounted in glass handle, as shown by Figs. 4500 and 4502; and 4 platinum wires not mounted in glass, for use with Fig. 4503; *the complete set, £5 5s.*



- 01. Gas Burner, like Fig. 4501, 5s.
- 02. Support for Platinum Wires, by which the salts put on the end of the wire can be placed exactly in the proper part of the flame produced by the gas burner, Fig. 4502, 2s.
- 03. Support for Platinum Wires, of the form of Fig. 4503, 2s. 6d.
- 04. Platinum Wires, mounted in glass handles, for use with the support No. 4502, 6d.
- 05. Platinum Wires, unmounted, for use with the support No. 4503, 3 inches long, 3d.

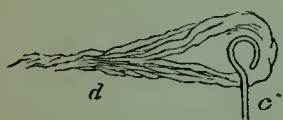
4506. *Description.*—The Spectroscope is represented by Fig. 4500, as arranged for use. The top of the table rotates upon the pedestal. The prism which produces the spectra is fixed vertically on the centre of the table by a spring, one end of which is screwed to the table, while the other presses upon the prism. The three tubes are firmly screwed to the table in proper positions, one towards the other. The tube in front is that by which observations are made. It is a telescope, giving a six-fold magnifying power, and an objective of $\frac{1}{4}$ inch diameter. The tube on the right end carries a slit, through which the light from the coloured flame produced by the chemical placed in the gas flame is admitted. The tube has a screw to regulate the width of the slit, and one end of the slit is covered with an additional prism, to enable the operator to observe two spectra at the same time. The tube on the left hand carries a photographic scale, marking 190 degrees on a right line, visible bright upon a dark ground. When two spectra are observed at the same time, one is seen below this scale, and the other above it. The axes of the two tubes are directed at the same angle upon one plane of the prism, and the axis of the telescope tube is directed upon the other plane of the prism. The telescope and the prism are so placed that the deviation of the rays of the soda flame are at a minimum, and the red and violet lines of the potassium flame fall at equal distances from the middle of the field of view. When the flame is put opposite the tube that carries the slit, the table is made to rotate until the spectrum is seen with the greatest amount of light. To keep off dust and extraneous light from the prism and the telescopes, the centre of the apparatus is covered with a black leather cap.

The gas lamp which illuminates the scale in the left hand tube is also attached to the iron *a*, and revolves with it and the scale, so that in every position the scale is properly lighted.

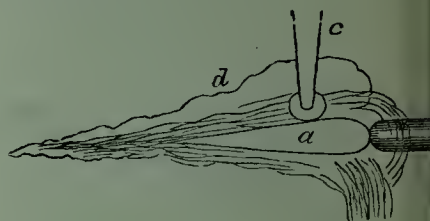
The vapours to be observed are produced as follows:—The heat is supplied by a Bunsen's burner, Fig. 4501, which has a star support, and a short conical chimney to steady the flame. Salt to be tried is taken up on the end of the platinum wire, 4502, and the glass tube attached to the wire is put upon the projecting horizontal wire of the support 4502. This wire is attached to a spring, which slips up and down the rod of the support 4502, and thus makes it easy to put the substance in a proper part of the flame. Another method of supporting the platinum wire is shown by Fig. 4503, where the spring on the vertical rod carries a slight clip, between the jaws of which the platinum wire is stretched, so that one end of it which carries the salt to be tried can be put in the flame.

BLOWPIPE EXPERIMENTS ON COLOURED FLAMES.

4507. Many salts and other chemicals, when heated in the Blowpipe flame, produce coloured flames, which serve to indicate the presence of particular elements, principally metals. A full account of such coloured flames was given in my work on Chemical Manipulation, published in 1838. The method of operating is represented in Figs. 4507 and 4508.



4507.



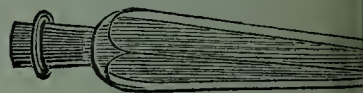
4508.

In Fig. 4507 the salt to be tried is held on a platinum wire at the point of the Blowpipe flame. In Fig. 4508 the salt, held in platinum tongs, is dipped into the upper part of the blowpipe flame. Soda gives a large and brilliant yellow flame when tried as 4507; potash gives a violet-coloured flame, but so much more feeble than the soda flame, that a mixture of 300 parts of potash and 1 part of soda shows only the yellow flame. Strontium chloride held as in 4508, and wetted with water, gives a brilliant crimson flame. In general soluble salts of the earths give their characteristic colours best when moistened with water or acid and tried as 4508, but insoluble salts are treated as in 4507. These experiments require only the ordinary blowpipe supports, which, however, must be carefully washed in distilled water, and never be wetted in the mouth.

APPARATUS FOR CHANGING THE COLOURS OF BLOWPIPE FLAMES.

4509. SQUARE PLATE of BLUE GLASS, through which to examine the Colours of Blowpipe flames, size 3 by 2 inches, 1s.

4510. GLASS PRISM to contain a solution of SULPHATE of INDIGO, through which to examine the colours of Blowpipe flames, size of the prism, 9 inches long, $1\frac{3}{4}$ inch wide. Fig. 4510, 3s.



4510.

The appearances of coloured flames are so curiously changed when they are looked at through these blue diaphragms, that different elements can be discriminated when their salts are mixed together. The following examples of the changes produced:—

a. The Yellow flame of Sodium becomes light blue when seen either through the blue glass or blue liquid.

b. The Violet flame of Potassium is visible through the blue glass and the blue liquid.

Consequently, the presence of potassium can be easily detected in the presence of a large quantity of Sodium.

c. The Crimson flame of Lithium can be seen through the indigo prism, but not through the blue glass.

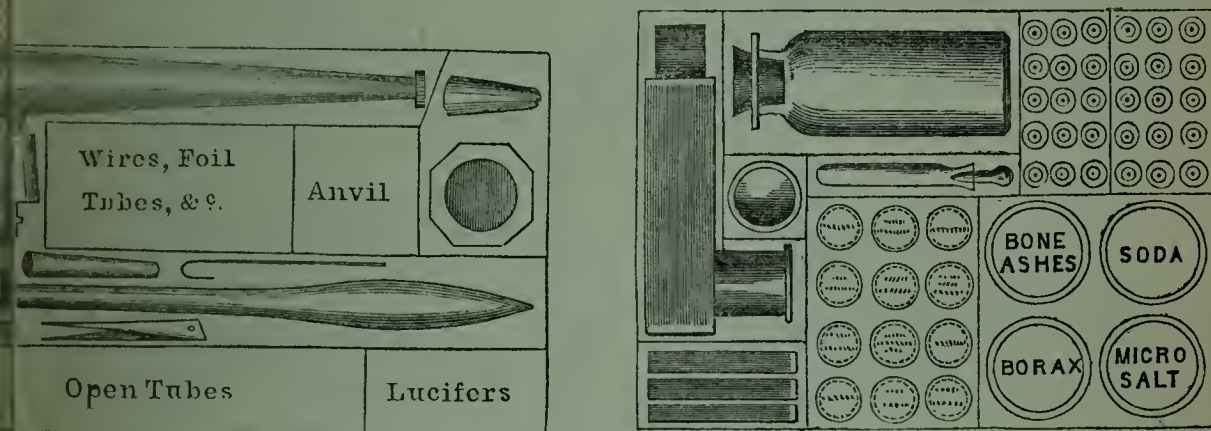
Consequently, potassium can be found in the presence of lithium by using the blue glass, and lithium can be found in the presence of sodium by using the prism. A mixture of the three metals gives an orange flame naturally; but when this is seen through the blue glass, only the violet flame of potassium appears; and when seen through the indigo prism, only the crimson flame of lithium is apparent.

For farther details consult CARTMELL, *Philos. Mag.*, Nov. 1858; and BUNSEN, *Annal. Chemie*, Band cxi.

When coal gas is available, the observations on coloured flames can in many cases be very easily made by using the apparatus represented by Figs. 4501, 4502, 4503, and dispensing with the blowpipe.

CABINETS OF BLOWPIPE APPARATUS SUITABLE FOR QUALITATIVE EXPERIMENTS.

520. The Cabinets, Nos. 4521 to 4527 contain the Instruments and Tests necessary for Qualitative Analyses by the Blowpipe. The sets are prepared with apparatus of the newest and most improved patterns, and they are more or less complete according to their respective Prices. The sets, Nos. 4522 to 4527 are made of japanned tinplate, in a flat rectangular form, with divisions to keep the numerous small instruments in order ready for use; somewhat as represented by Fig. 4520. The pocket-case, No. 4521, has no divisions in it. None of these cabinets contain the articles necessary for Plattner's QUANTITATIVE operations, nor for experiments in the *wet way*.



4520.

The marginal numbers printed in the lists of contents refer to descriptions or figures of the articles in the preceding pages.

1. POCKET CABINET OF BLOWPIPE APPARATUS, contained in a Japanned tinplate case, oval form, with pull-off cover, size 5 inches high, and the oval $1\frac{1}{2}$ by 3 inches, price 10s. 6d.

CONTENTS as follow.—

- | | |
|---------------------------------------|--|
| Flexible Blowpipe. | 4360. Open Glass Tubes, $4\frac{1}{2}$ inch (six). |
| Tongs with Platinum points. | 4363. Closed Glass Tubes, 2 inch (three). |
| Platinum Foil, two pieces. | 4363. Closed Glass Tubes, $1\frac{1}{2}$ inch (three). |
| Platinum Wire, three pieces. | 4365. Glass Bulb Tube. |
| Platinum Capsule, $\frac{1}{4}$ inch. | 4367b. Glass Bulb Tube. |
| Copper Wire, 12 inches. | Borax in a bottle. |
| Charcoal Supports (eighteen) | Soda ditto. |
| a. Wires to hold ditto (two). | Microcosmic Salt ditto. |
| Porcelain Crucible for ditto. | Cobalt Nitrate ditto. |
| Spatula and Spoon, albata. | Japanned Tin case. |

- a. Pocket Blowpipe Lamp, cylindrical form, with screw cap to prevent the escape of oil. Price 2s

4522. CABINET OF BLOWPIPE APPARATUS, containing the principal instruments required in the Study of Blowpipe Analysis and for the identification of most Mineral and Chemical substances, arranged in one divided case, of Japanned tinplate, size 11 inches long, $7\frac{1}{2}$ inches wide, and $1\frac{1}{2}$ inch deep. Price 21s.

CONTENTS OF THIS COLLECTION :

- | | |
|--|---|
| 4200. Conical Blowpipe. | 4321a. Wire Supports for Crucible (2). |
| 4213. Extra Nozzle for ditto. | 4284. Platinum Capsule, $\frac{1}{4}$ inch. |
| 4218. Drill to clear Blowpipe nozzle. | 4395. Blowpipe Hammer. |
| 4230. Blowpipe Lamp on Stand. | 4397. Blowpipe Anvil. |
| 4249. Cotton Wick for Lamp. | 4411. Porcelain Mortar and Pestle. |
| 4410a. Brass Tongs to trim Lamp. | 4409. Spatula and Spoon, albata. |
| 4270. Platinum Wires (2). | 4436. Tinfoil, 6 rolls. |
| 4277. Platinum Foil (2). | 115. Glass Stirrer, 3 and 6 inch. |
| 4282. Tongs with Platinum points. | 2423. Test Papers, 5 books. |
| 4276. Copper wire, thin, 12 inches. | 4360. Open Glass Tubes, 6 inch (12). |
| Borax in a bottle. | 4370. Bulb and Arsenic Tubes (6). |
| Soda in a bottle. | 4363. Closed Glass Tubes, 3 inch (4). |
| Microcosmic Salt in a bottle. | 4363. Ditto 2 inch (4). |
| Cobalt Solution in a bottle. | 4363. Ditto $1\frac{1}{2}$ inch (4). |
| 4321. Charcoal Supports (36). | Japanned Tin Case. |
| 4320. Porcelain Crucibles for ditto (2). | |

4523. COLLECTION OF BLOWPIPE APPARATUS arranged in two DIVIDED JAPANNED TIN CASES, measuring $10\frac{3}{4}$ inches in length, $6\frac{3}{4}$ inches in width, and respectively $1\frac{3}{4}$ inch and $1\frac{3}{8}$ inch in depth. Price £3 13s. 6d.

CONTENTS :—

- | | | |
|--|--------------------------------------|---------------------------------------|
| 4200. Conical Blowpipe. | 4422. Triangular Cutting File. | |
| 4213. Extra nozzle for ditto. | 115. Glass Stirrers, 3 and 6 inch. | |
| 4218. Drill to clear Blowpipe nozzle. | 4360. Open Glass Tubes, 6 inch (12). | |
| 4232. Blowpipe Lamp with screw-cap. | 4363. Closed Ditto 3 inch (4). | |
| 4241. Brass Lamp Support. | 4363. Ditto 2 inch (4). | |
| 4249. Cotton Wick for Lamp, 1 yard. | 4363. Ditto $1\frac{1}{2}$ inch (4). | |
| 4414a. Iron Tongs to trim Lamp. | 4375. Arsenic Tubes, 3 sorts (6). | |
| 4281. Tongs with Platinum points, best. | 4367. Bulb Glass Tubes, 3 sorts (6). | |
| 4270. Platinum Wires (6). | 4436. Tin Foil, 6 rolls. | |
| 4277. Platinum Foil (3). | 2423. Test Papers, 5 books. | |
| 4276. Copper Wire, thin, 12 inches. | Potassium Bisulphate | } in stoppered glass bottles |
| 4321. Charcoal Supports (36). | Cobalt Nitrate | |
| 4320. Porcelain Crucibles for ditto (2). | Potassium Cyanide | |
| 4321a. Wire Supports for ditto (2). | Borax | |
| 4322. Iron Mould for making Pastilles. | Soda | } in large wooden boxes |
| 4307. Charcoal Mixture for ditto. | Microcosmic Salt | |
| 4349. Support for showing Sublimates. | Bone Ashes | |
| 4351. Clay Support for Cupels. | Gypsum | |
| 4414. Iron Tongs with Spoon. | Nitre | } In hardwood boxes, with screw tops. |
| 4284. Platinum Capsules, $\frac{1}{4}$ inch (2). | Silica | |
| Ditto, $\frac{3}{8}$ inch, with handle. | Fluorspar | |
| Ditto, 1 inch, with handle. | Lead | |
| 4283. Steel Spring Tongs to hold ditto. | Iron Wire | |
| 4399. Steel Crushing Mortar. | Graphite | |
| 4400b. Agate Pestle and Mortar, 2 inch. | Starch | |
| 4395. Blowpipe Hammer. | Rock Salt | |
| 4397. Blowpipe Anvil. | Nickel Borate | |
| 4404. Steel Spatula. | Potassium Oxalate | |
| 4409. Albata Spatula and Spoon. | Boracic Acid | |
| 4424. Magnetised Chisel. | Pair of Divided Japanned Tin Cases. | |
| 4421. Flat File for testing minerals. | | |

4524. COLLECTION OF BLOWPIPE APPARATUS, arranged in two DIVIDED JAPANNED TIN CASES. Price £3 3s.

CONTENTS.—Precisely the same as the preceding collection, excepting that the $\frac{3}{8}$ inch and 1 inch Platinum Capsules are omitted.

525. COLLECTION OF BLOWPIPE APPARATUS, arranged in TWO DIVIDED JAPANNED TIN CASES. Price £2 12s. 6d.

CONTENTS.—The same Cabinets and the same articles as No. 4523, with the following alterations:—the Platinum Capsules of $\frac{3}{4}$ inch and 1 inch diameter are omitted; the Steel Crushing Mortar, No. 4399, is omitted; the Platinum-pointed tongs, No. 4281, are exchanged for No. 4282; and the agate Mortar, No. 4400b is exchanged for No. 4400a. The other articles are the same, both in number and quality, as in the collection at £3 13s. 6d.

526. SOLID MAHOGANY CABINETS, French polished with lock and key, of a size to hold the two japanned cases with the collections of apparatus Nos. 4523, 4524, or 4525, price 10s. 6d. *extra*.

527. COLLECTION OF BLOWPIPE APPARATUS, very complete, for Qualitative Analysis, arranged in THREE DIVIDED JAPANNED TIN CASES, measuring $10\frac{3}{4}$ inches in length, $7\frac{1}{4}$ inches in width, and respectively 2 inches, $1\frac{1}{2}$ inches, and $1\frac{1}{4}$ inches in depth. *The Set*, price £5 5s.

CONTENTS OF THIS COLLECTION OF APPARATUS:—

04. Conical Blowpipe, brass.	14. Blowpipe Anvil, $1\frac{1}{4}$ inch.
13. Extra nozzle, for ditto.	4400c. Agate Mortar and Pestle, $2\frac{1}{4}$ inch.
32. Lamp with screw cap.	4399. Steel Crushing Mortar.
41. Plattner's Brass Stand for lamp.	4409. Spatula and Spoon, albata.
18. Drill to clear Blowpipe nozzle.	4404. Steel Spatula.
14a. Iron Tongs to trim lamp.	4414. Iron Tongs with Spoon.
49. Cotton Wick for lamp, 2 yards.	Steel Tongs fine bent points.
31. Tongs with Platinum points, best.	4422. Triangular Cutting File.
70. Platinum Wires (12).	4421. Flat File for trying Minerals.
74. Handle and box for Platinum Wires.	4424. Magnetised Chisel.
77. Platinum Foil (8).	4418. Cutting Pliers.
76. Copper Wire, fine, 2 feet.	4430. Pair of Bar Magnets in box.
35b. Platinum Spoon with handle.	4402. Brass Scoop for powders.
33. Spring Steel Tongs, to hold ditto.	4425. Plate to try streak of minerals.
64. Platinum Capsules $\frac{1}{4}$ inch (2).	4360. Open Glass Tubes, 8 inch (12).
64. ditto. $\frac{3}{4}$ „	4363. Closed Glass Tubes, 3 inch (4).
64. ditto. 1 „	4363. ditto ditto 2 „ (4).
71. Charcoal Pastilles (72).	4363. ditto ditto $1\frac{1}{2}$ „ (4).
70. Porcelain Crucibles for ditto (2).	4371, 5. Arsenic Tubes, 3 sorts (6).
1a. Wire Supports for ditto (2).	4370. Bulb Glass Tubes, 3 sorts (6).
6d. Porcelain Capsules, 1 inch (3).	4365. ditto ditto (6).
2. Iron Mould for making Pastilles.	115. Glass Stirrers, 3 and 6 inch (4).
7. Charcoal mixture for ditto.	Glass pipette for Cobalt drops, (3).
9. Support for showing Sublimates.	4436. Tin Foil, 12 rolls.
1. Clay Support for Cupels.	2423. Test Paper, 6 books.
5. Blowpipe Hammer.	1800. Flat Porcelain Capsule $1\frac{1}{2}$ inch.
3. Blowpipe Crucible and Cover.	Gypsum
3. Porcelain Crucible and Cover.	Nitre
0. Porcelain Cup, fig. 1.	Silica
0. ditto fig. 2.	Fluorspar
0. ditto fig. 3.	Lead
Potassium Bisulphate	Iron Wire
Potassium Cyanide	Graphite
Cobalt Nitrate	Starch
Borax	Rock Salt
Soda	Nickel Borate
Mircrocsmic Salt	Potassium Oxalate
Bone Ashes	Boracic Acid
	Three Japanned Tin Cases with divisions.

In small boxes
with screw top.

528. SOLID MAHOGANY CABINET, French polished, with lock and key, of a size to hold the three japanned tin cases containing the foregoing collection of Blowpipe Apparatus, price 15s. *extra*.

CABINETS OF BLOWPIPE APPARATUS, AFTER THE METHOD OF PLATTNER, SUITABLE BOTH FOR QUALITATIVE AND QUANTITATIVE ANALYSIS

4529. COMPLETE SET OF PLATTNER'S BLOWPIPE APPARATUS, made precisely after his patterns and in the first style of workmanship, £24.

The apparatus and tools are arranged in a mahogany box, which measures 12 by 9 by 7 inches and which contains several boxes and trays, lined with velvet into which the instruments are stored. There is a special box that contains the fine balance and weights, and all that concerns the operation of weighing. A mahogany box, measuring 12 by 9 by 4 inches, contains the bottles and boxes that are filled with reagents, solid and liquid. Several small boxes contain the various glass vessels for operations to be performed in the wet way. A box for the capsules and crucibles that are made of charcoal and clay, according to Plattner's directions. A folding mahogany glass case for the balance. These comprise in all 4 packages, which are inclosed for travelling in a strong divided leather case studded with brass knobs, and which measures 14 inches in length, 12 inches in width, and 12 inches in depth.

THE CONTENTS OF THIS COLLECTION ARE AS FOLLOWS:—

In most instances, the figures referred to in the marginal numbers, agree with the articles in the cabinet; but in some cases, there are differences which are not exactly represented by the woodcut in the preceding pages. These are either left without reference, or else reference is made to the nearest approximate figures.

- | | |
|---|---|
| 4235. Brass Lamp. | 4400 c. Agate Mortar 2½ inch. |
| 4241. Brass Stand. | 4274. Platinum Wire Holder. |
| 4243. Support for Basins. | 4270. Platinum Wires. |
| 4243. Support for Crucibles. | 4285 a. Platinum Spoon, ⅝ inch. |
| Lamp Chimney. | 4285 b. ditto. ⅜ inch. |
| Support for ditto. | 4286. Handle for ditto. |
| Double funnel ring. | 4384. Sieve for fine Lead. |
| 4203. Blowpipe (Argentan). | 4402. Mixing Capsule, brass. |
| 4215. Platinum nozzles (3). | 4403. ditto. horn. |
| 4380. Cupel support. | 4420. Penknife, folding. |
| 4396. Hammer, polished. | 4385. Measure for Lead. |
| 4398. Anvil, polished. | 4441. Cylinder for Soda papers. |
| 4416. Pliers, polished. | 4340. Mould for Clay Capsules. |
| 4418. Cutting Pliers, polished. | 4440. Soda papers in box. |
| 4281. Tongs with Platinum points. | 4419. Strong Scissors, 4½ inch. |
| 4411. Tongs to trim lamp. | 4389. Ivory Scale for Gold Beads. |
| 4412. Fine Brass Tongs. | 4404. Iron Spatula, polished. |
| 4424. Magnetic Chisel. | Spirit Lamp, brass top. |
| 4304 a. Charcoal Borer. | 4434. Double Lens. |
| 4304 b. ditto. | 4432. Brush for Beads of metal |
| 4304 c. ditto. | 4406. Ivory Spoon. |
| 4421. Flat File. | 4300. Charcoal Saw. |
| 4422. Triangular File. | 4249. Cotton Wick, 1 yard. |
| 4423. Rat Tail File. | 4387. Assay Balance, with weights, nippers, |
| 4245. Bottle for Oil. | 2 pairs Gold capsules, 1 pair Platinum |
| 4246. Bottle for Spirit. | capsules; 2 gilt plates, 2 glasses, ivory |
| 4345. Box for Crucibles and Capsules. | spoon, &c., in a box. |
| 4329 a. Box for Square Charcoals. | 4329. Charcoal Crucibles and Covers (6). |
| Japanned Funnel for Oil. | 4322 b. Rectangular Charcoal (2). |
| 4343. Mould for Clay Crucibles. | 4344. Clay Crucibles (12). |
| 47. Steel Crushing Mortar. | 4342. Clay Capsules (8). |
| 4330. Charcoal Roasting Furnace. | 4326. Charcoal Crucibles (12). |
| 4333. Platinum Wire and Foil for ditto. | 4325. Charcoal Capsules (12). |

PLATTNER'S COMPLETE SET OF BLOWPIPE APPARATUS, *continued*—

The following for Experiments in the Wet Way, but including all the Reagents for both Wet and Dry Way.

Bottles $\frac{1}{2}$ oz with ground stoppers and engraved name (14), containing :—

Sulphuric Acid.
Nitric Acid.
Hydrochloric Acid.
Acetic Acid.
Ammonia.
Potash.
Soda.
Ammonium Sulphide.
Cobalt Nitrate.
Alcohol.
Platinum Chloride.
Boracic Acid, *fused*.
Ammonia Carbonate.
Potash Bisulphate.

Bottles $\frac{1}{4}$ oz. glass stoppers with labels (9), containing :—

Bone Ash, *sifted*.
Bone Ash, *washed*.
Borax glass.
Ammonia Molybdate.
Iron Sulphate.
Plattner's Flux.
Potassium Cyanide.
„ Antimoniate.
„ Oxalate.

Turned Wooden Boxes with pull-off Tops, labelled (22), containing :—

Oxalic Acid.
Charcoal and Clay.
Microcosmic Salt.
Borax.
Soda Carbonate.
Assay Lead.
Nitric cryst.
Graphite.
Sodium Chloride.
Starch.

Iron Wire.
Arsenic.
Fluorspar.
Silica.
Copper, Black Oxide.
„ Sulphate.
Potassium Ferrocyanide.
Lead Acetate.
Sal Ammoniac.
Nickel Oxalate.
Tartaric Acid.
Gypsum.

Porcelain :—

4450 b. Deep Capsules, $1\frac{3}{4}$ inch (2).
1800, 12. Flat Capsules, $1\frac{1}{2}$ inch (2).
1800, 12. ditto. $1\frac{1}{2}$ „
1800, 12. ditto. $1\frac{3}{4}$ „
1800, 12. ditto. 2 „

Glass Apparatus :—

4472. Schuster's Bottle with tube.
4453. Beaker Glasses, $2\frac{1}{4}$ inch (2).
4460. Glass Funnel $1\frac{1}{2}$ inch (2).
4470. Glass Stirrers, 3 inch (2).
4454. Watch Glasses $1\frac{3}{4}$ inch (2).
Bulb Pipette, small (2).
4373. Arsenic Tubes (4).
4371. ditto. (2).
Potassium Sulphate, in paper.
Platinum flat Wires (5).
Slip of thin Silver.
Slip of thin Tin.
1725. Washing Bottle, 2oz.
4365. Bulb Tubes (6).
4370. ditto. (6).
4366. Holder for hot tubes.
4360. Open Glass tubes, 10in., (6).
4457. Tube frame for 6 Tubes.
4456. Test Tubes to fit it (6).
Boxes and Cases, as enumerated above.

30. ANOTHER CABINET OF PLATTNER'S BLOWPIPE APPARATUS, suitable both for Qualitative and Quantitative Analysis, in the same style as the foregoing set, but not quite so complete. It is without the folding glass case for the balance and the outer leathern case, and a few other articles. Price £18.

31. APPARATUS FOR QUANTITATIVE ANALYSES ONLY.

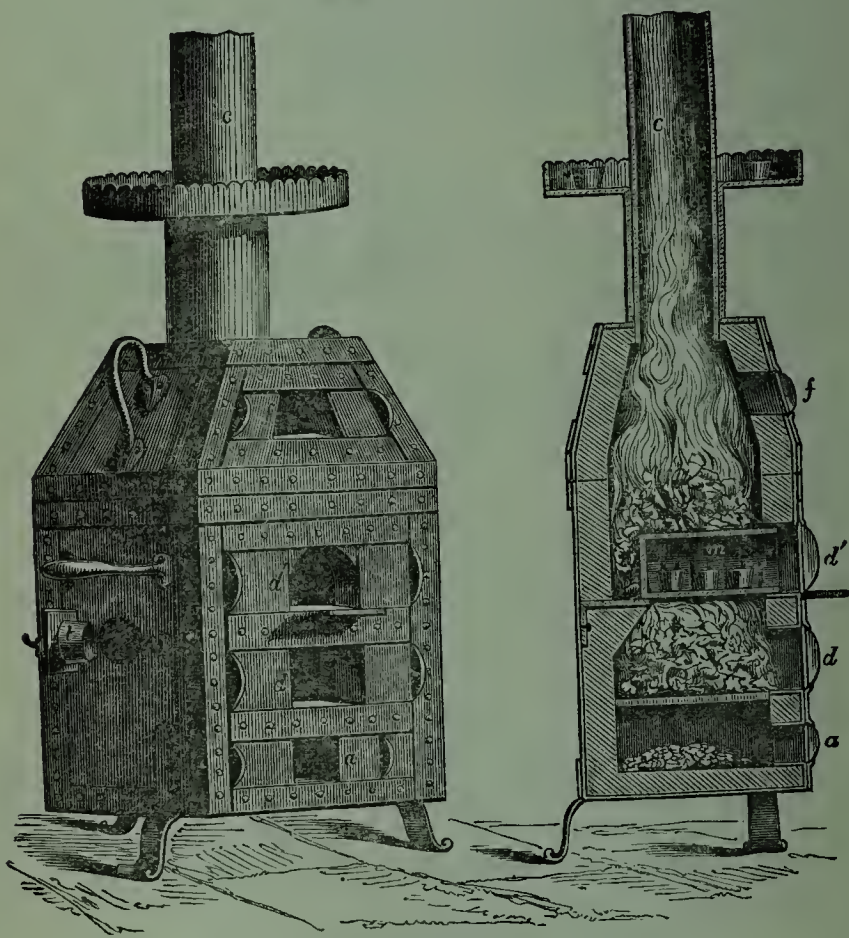
Those who already possess the ordinary blowpipe apparatus for QUALITATIVE experiments, and wish to add to their collection, the instruments necessary for QUANTITATIVE experiments and FUSION, can select them from the preceding lists, to suit their requirements.

32. CABINETS OF APPARATUS and TESTS for Analyses in the *Wet Way*, are described in a subsequent section of this work.

Apparatus for Assaying and for Metallurgical Operations in General.

In this section only those articles are noticed which especially belong to the subject of Metallurgy and which have not come fully under notice in other sections. Thus Furnaces, Crucibles, Instruments for Assaying in the wet way, and other articles which belong to special sections, are there fully described, are not repeated in this section, it being presumed that the index, or the systematic plan of this work, will direct the enquirer to the desired information.

CUPELLATION.



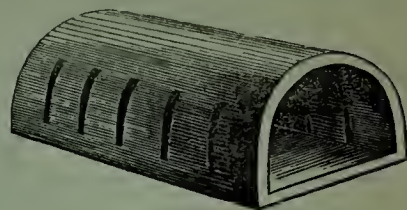
4540.

4540. CUPELLING FURNACE, of wrought-iron plate, lined with fire-clay, with two openings for heating a tube, form of Fig. 4540. This size of furnace suitable for a muffle measuring inside 9 inches long and $4\frac{1}{2}$ inches. The fire-room is 10 inches long, and 9 inches wide, £5 5s.

4541. Muffles for this furnace, each 3s.

4542. A LARGER CUPELLING FURNACE, also of wrought-iron plates lined with clay, Berlin pattern; this furnace is in three pieces. The fire-room 12 inches long, and 12 inches wide. The inside floor of the muffle 12 inches long, and 5 inches wide, £7.

443. Muffles for the Cupelling Furnace, No. 4542, each 3s. 6d.
 444. Fireclay, prepared, in powder, requisite for fixing the muffles in the door of the furnace, and for repairing cracks in the lining of the furnace, 28 lb. for 2s.
 445. Muffles, Fireclay, best London make, Fig. 4545. Orders for Muffles should state the external length, breadth, and height with precision. They can be supplied up to 12 in. long, by 8 in. wide.



4545.

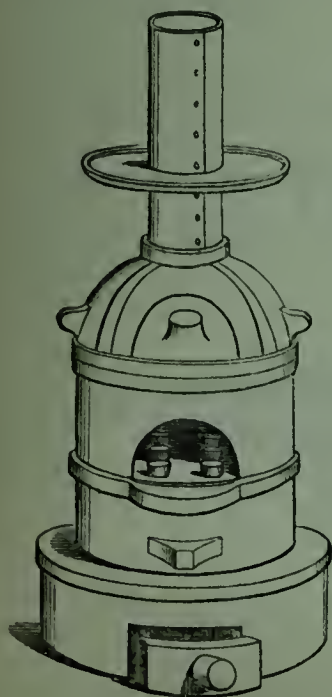
For prices of Muffles, see Nos. 4546 and 4547.

446. FRENCH CUPELLING FURNACES, oval form, fireclay, style of Fig. 4546, with double sets of doors, and separate base. Paris make.

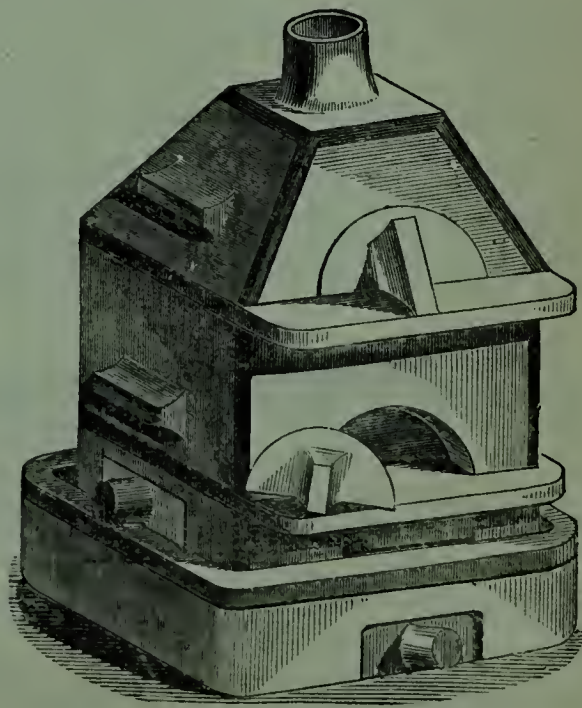
APPROXIMATE MEASUREMENTS :

Inner Dimensions of the Furnaces.				Corresponding Muffles.			
No.	Length.	Width.	Price.	Width.	Height.	Length.	Price.
	Inches.	Inches.	£ s.	Inches.	Inches.	Inches.	s. d.
1	7	5	1 7	2 $\frac{3}{4}$	2	4	1 3
2	8	6	2 5	3 $\frac{1}{4}$	2 $\frac{3}{4}$	4 $\frac{3}{4}$	1 9
3	9	7	3 3	3 $\frac{1}{4}$	3	5	2 0
4	10	8	4 10	4 $\frac{1}{4}$	3 $\frac{1}{2}$	6	2 6
5	11	9	6 0	5	4	7 $\frac{1}{2}$	3 0

The French muffles are thin, porous, and tender. The English muffles, No. 4545 and 4547 are stouter, harder burnt, and less fragile.



4546.



4547.

4547. CUPELLING FURNACES of Fireclay, LONDON make, square form, Fig. 4547.

Approximate Measurements of the Furnaces.				Corresponding Muffles.		
No.	Diameter Inside Square.	Height Outside, Not Including the Base.	Price.	Width.	Height.	Price.
	Inches.	Inches.	£ s.	Inches.	Inches.	s. d.
1	9½	19	2 4	3½	2½	2 6
2	10	20	2 10	4	2¾	2 9
3	10½	21	2 16	4½	3	3 3
4	11	22	3 10	5	3¼	3 6
5	12	24	4 0	5¾	3¾	3 9
6	13	26	5 0	6	3¾	4 6

4548. ASSAY BALANCES. Consult the article on Balances, commencing at page 40 especially at the following numbers:—

418. Assay Balance in mahogany glass case, £3 3s.

434. Ditto, in a box without glass case, £2 10s.

419. Another Assay Balance, in glass case, £8 8s.

420. Best Assay Balance, in glass case, £28.

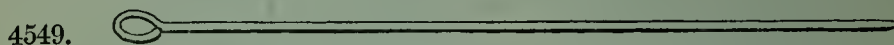
464. Assay Weights for gold, ½ gramme=1000, 30s.

465. Assay Weights for silver, 1 gramme = 1000, 30s.

TOOLS USED WITH THE CUPELLING FURNACE.

4549. Iron Rod, or Poker, for arranging the fuel in the furnace, Fig. 4549, 3 feet long, ⅝ inch diameter, 2s. 6d.

4550. Ditto, larger, 3½ feet long, ⅝ inch diameter, 3s.

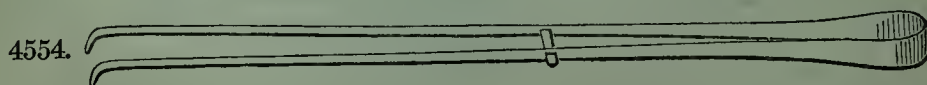


4551. Bar Scraper, for clearing the grate, detaching slags, and causing the fuel to descend in the furnace, Fig. 4551, 3 feet long, ⅝ inch rod, 3s. 6d.

4552. Long Iron Rod, flattened (chisel form) at one end, and a ring at the other 3 feet long, ⅝ inch rod, Fig. 4552, 3s.



4553. Cupel Tongs, or Long Iron Tongs, for removing Cupels into or out of the Muffle, elastic iron, 30 inches long, form of Fig. 4553, 5s.



4554. Cupel Tongs, for removing Cupels into and from the Muffle, form of Fig. 4554, made of elastic iron, 30 inches long, 5s.

555. Scorifier Tongs for lifting Scorifiers or Cupels and arranging them in the Muffle, Fig. 4555. Elastic iron, length, 25 inches, two sizes, *each* 1s. 6d.

4555.



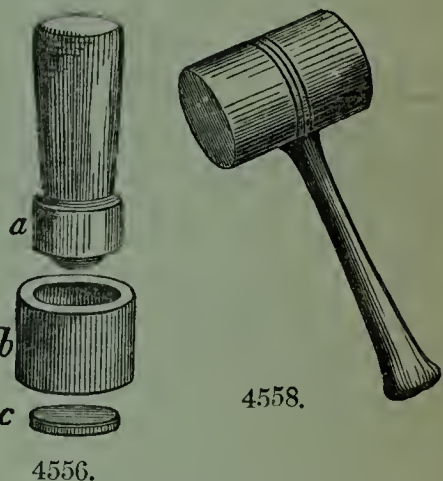
- A. with the jaws 1 inch wide.
B. with the jaws $1\frac{3}{4}$ inch wide.

556. Cupel Moulds, form of Fig. 4556. The parts *a*, *b*, *c*, of polished iron. The handle of boxwood.

- No. 1. For Cupels of 1 inch diameter, 9s.
,, 2. For Cupels of $1\frac{1}{4}$ inch diameter, 10s. 6d.
,, 3. For Cupels of $1\frac{1}{2}$ inch diameter, 10s. 6d.
,, 4. For Cupels of 2 inch diameter, 14s.

557. Cupel Moulds, form of Fig. 4556, but made entirely of boxwood or other tough wood that will bear blows and pressure.

- No. 1. For 1 inch Cupels, 3s.
,, 2. For $1\frac{1}{4}$ inch Cupels, 3s. 6d.
,, 3. For $1\frac{1}{2}$ Cupels, 4s.
,, 4. For 2 Cupels, 5s.



- 558 Wooden Mallet for driving the Die into the Ring of the Cupel Mould, Fig. 4558, 3s.

559. Cupels of any size made to order.

560. Cupel Trays with square divisions, $\frac{1}{2}$ inch deep, the holes of any size and of any number. *Prepared to order.*

561. Flatting Mill, a pair of Steel Rollers, mounted in an iron frame, for rolling metal into sheets; used especially for flattening alloys of gold and silver, in preparation for the operation of parting, 3 inch rollers, £7.

562. Hammer for flattening Buttons of Metal in Silver Assaying, small size, 2s. 6d.

563. Ditto, large size, 3s.

564. Hammer for flattening Buttons of Gold, weight about six pounds, bright face, 6s.

565. Assay Pots, for melting gold (Cornet Pots), Fig. 4565.

- A. $1\frac{1}{8}$ inch high, $1\frac{1}{8}$ inch diameter, per dozen, 2s. 6d.
B. $1\frac{7}{8}$ inch high, $1\frac{5}{8}$ inch diameter, per dozen, 2s. 6d.
C. $2\frac{1}{4}$ inch high, 2 inch diameter, per dozen, 3s.

GLASS PARTING FLASKS, for assaying alloys of gold and silver.

570. Conical form of flask, flat bottom, with welt round the neck, Fig. 4570, 4 ounce size, *per dozen*, 3s. 6d.



4565.



4574.



4570.



4571.



4572.

4571. French form of flask, with long neck, Fig. 4571, of 1, 2, 3, 4, or 5 ounces capacity, *per dozen*, 2s. 6d.
 4572. Pear Shaped form of flask, round bottom, Fig. 4572, 3 ounce size, *per dozen*, 2s. 6d.
 4573. Iron Tongs, for lifting Hot Parting Flasks, Fig. 4570, 1s. 3d.
 4574. Iron Tongs, mounted with cork, for lifting hot flasks, Fig. 4574, 1s. 6d.

ASSAY OF SILVER BY THE WET WAY.

According to Gay Lussac.

4580. This process is described in detail in RORET'S *Manuel complet de l'Essayeur*. An abstract given in English, in MITCHELL'S *Manual of Assaying*. In both these works the measurements are given in Grammes and Centimetre Cubes. In MILLER'S *Elements of Chemistry*, 1856, vol. ii., p. 10, the process is described with reference to English grains. The graduation of the apparatus can be made to suit either of these methods of reckoning. In the following List, the apparatus is supposed to be divided into CENTIMETRE CUBES. It is particularly requested that in any order given for this apparatus, it will be stated whether French or English graduation is desired.
4581. Large Stoneware Jar, for graduated salt test; containing 90 litres, with three necks, and gauge tube, graduated to show spaces of 5 litres, 42s.
 4582. Safety Tube, to supply air to this jar, 1s. 3d.
 4583. Glass Stopcock, 3s. 6d.
 4584. Woulff's Bottle, with Three Necks, size 5 litres, to be mounted in a water bath, by which the temperature can be adjusted for the supply of solution, for use in very cold weather, 6s. 6d.
 4585. Standard Thermometer, 100° C. enclosed in glass tube, with cork, 10s. 6d.
 4586. Double air-way Stopcock and connector, for pipette, with Mohr's pinchcock (on the plan recommended by Varrentrap. See *Handwörterbuch der Chemie* VII. 921); the object of which plan is to supply the salt solution without its coming into contact with any metal, 31s. 6d.
 4587. Pipette, to measure 100 CC of salt solution, with male screw to fix it, and space on the neck of the tube of 2 CC divided into $\frac{1}{10}$ CC, to increase or diminish the measure delivered by 1 or more thousandth parts, according to the temperature of the liquor at the time; with a brass spring clip to direct the eye upon the proper line of graduation that is to be observed, 5s.
 4588. Mahogany Support for the Pipette, of the form of Fig. 2730, 5s.
 4589. Pipette mounted with a Silver Stopcock, with double air-way, on the original plan of Gay Lussac. (This is for use instead of No. 4586.) 45s.
 4590. Bottle Holder, on Wheels, with small railway for bringing the bottle exactly under the delivery pipette for salt, with wiper for the pipette, 14s.
 4591. Bottles, 10 ounce size, narrow mouth, with stoppers ground to a cone inside, and numbers engraved on bottle and stopper, 1 to 10, the set, 8s. 6d.
 4592. Gay Lussac's Hot Water Bath, for 10 bottles, 20s.
 4593. Small Bellows, with bent glass nozzle, for blowing nitrous acid out of 10 bottles, 4s. 6d.
 4594. Caoutchouc Ball, with glass, Fig. 1733, for the same use as the Bellows, 6 ounce size, 3s.
 4495. Circular Shaking Apparatus, for 10 Bottles, of zinc japanned green, 35s.
 4596. Japanned Tin Case, for Shaking a Single Bottle by hand, 2s.
 4597. Five Mohr's Burettes, each containing 25 CC divided into $\frac{1}{10}$ CC, provided with small pinchcocks and regulating screws, as represented by Fig. 2728, the object of which is to secure delivery of the decimal salt solution in small drops of perfectly equal size, provided also with Erdmann's float, Fig. 2728, and numbered in rotation 1 to 5:—the set of five complete, 100s.

598. Elegant Mahogany Frame to support this set of Burettes, form of Fig. 2710, but for five Burettes, provided on the base with a contrivance for bringing each numbered bottle exactly under its proper jet, the positions of the Burettes being all numbered in rotation 1 to 5, price 21s.
599. Mahogany Stand for a Single Mohr's Burette, form of Fig. 2697, 5s. 6d.
600. Burette for this Stand. similar to those described at No. 4597, 7s.

This Burette is for decimal standard silver solution. The five Burettes, No. 4597, are for the decimal salt solution.

601. Mohr's Burette, containing 50 CC, each divided into $\frac{1}{10}$ CC, with float, 7s. 3d.

The support No. 4600, or any of these described at No. 2697, serves for this burette.

602. Bottle with Cap, size 15 fluid ounces, marked "NITRIC ACID," with Pipette graduated to deliver 12 single CC. 4s. 6d.

603. Bottle with Cap, size 15 fluid ounces, marked "SALT $\frac{1}{10}$," with Pipette graduated to deliver 1 CC. 3s. 6d.

604. Bottle Stoppered, 1 pint size, marked "SALT $\frac{1}{10}$." 2s. 6d.

605. Bottle with Cap, size 15 fluid ounces, marked "Silver $\frac{1}{10}$," with Pipette to deliver 1 CC. 3s. 6d.

606. Bottle Stoppered, 1 pint size, marked "SILVER $\frac{1}{10}$." 2s. 6d.

The Bottles 4602 to 4606 are empty at these prices.

607. Bottle Stoppered, size 4 litres, labelled "Saturated Solution of Salt." 3s.

608. Pipette to deliver 10 CC., 10d.

609. Pipette to deliver 100 CC., 1s. 9d.

610. Flask to contain 5 Litres, without stopper, used to prepare normal solution of salt, 7s.

611. Stoppered Flask, to contain 1 Litre, 3s. 6d.

612. Test Mixer, tall form, similar to Fig. 2790, contents 1 Litre, graduated into 100°, 9s.

613. Chloride of Sodium, pure, per lb., 1s. 6d.

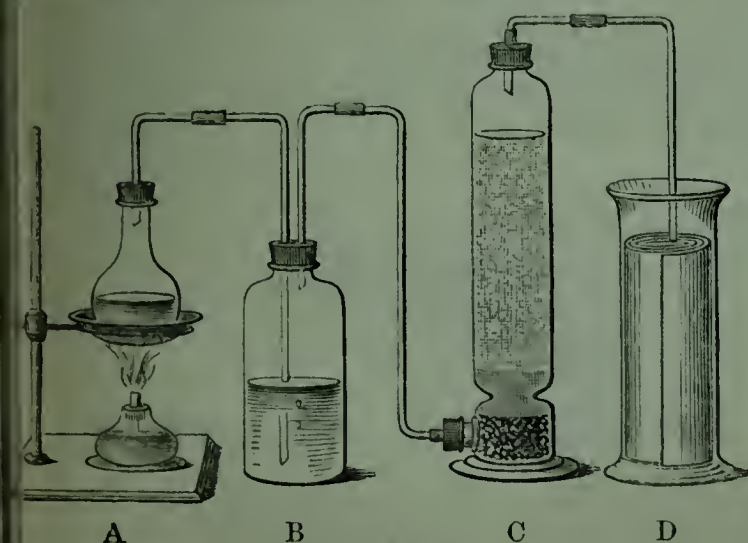
614. Rock salt, colourless and transparent, per lb., 1s.

615. Nitric Acid, pure, spec. gravity, 1.18, per lb., 1s.

616. Nitric Acid, pure. spec. gravity, 1.38, per lb., 1s. 6d.

Plattner's Apparatus for estimating in the Wet Way the Percentage of Gold contained in Crushed Quartz.

4625. Outline of the process for the extraction of Gold:—The rock quartz must be reduced to very



4625.

fine powder. If that has not been done in the large way, it must be done by means of a pestle and mortar. A quantity is then to be weighed off for testing. The apparatus described below serves to operate upon 2 lb. or $2\frac{1}{2}$ lb. avoirdupois of the ore. The powder must be thoroughly roasted at a red heat, to expel sulphur, arsenic, and other volatile substances. The roasted ore is then mixed with water, and is put wet into the glass cylinder C of Fig. 4625. Materials for producing chlorine gas are put into the flask A; the gas is washed in the bottle B, passed slowly and continuously through the cylinder C, and finally into the jar D, where the superfluous chlorine is absorbed by alcohol placed on

several folds of blotting paper. The gold contained in the cylinder C becomes converted into chloride

of gold. The apparatus, Fig. 4625 is then dismantled. The chloride of gold is washed out the cylinder C with water, and the gold contained in the solution is precipitated by a solution ferrous sulphate. The gold is collected, washed, and weighed.

4626. APPARATUS FOR THIS PROCESS:—

- a. Translation of Plattner's detailed Instructions for this process, 1s.
- b. APPARATUS FOR PULVERISING THE QUARTZ. See Steel Crushing Mortars, page especially No. 49, and Agate Mortars, page 6, especially No. 52.
- c. APPARATUS FOR WEIGHING THE ORE FOR TESTING. See Balance, No. 441; and Weights, No. 459.
- d. FOR WEIGHING THE GOLD EXTRACTED FROM THE ORE. The gold being obtained in but minute quantities a fine balance and delicate weights are required to weigh it. See Nos. 434, 445, 435, and others in the Section on Weighing, page 38.

4627. APPARATUS for ROASTING the ORE.

- a. French fireclay Chauffer, Fig. 803, 8 inch, 9s.
- b. Blower for ditto, to raise the heat, Fig. 797, 2s.
- c. Cast iron triangle to support the Tray on the Chauffer, 1s.
- d. Iron Tray in which to roast the ore over the Chauffer, 6 inches square, 1s. 6d.
- e. Iron Spatula to stir the hot ore, 9d.
- f. Pair of crucible Tongs to hold the Tray, 1s. 2d.
- g. Iron Mortar and Pestle to grind the ore after roasting, Fig 44, 5 inch, 2s.
- h. Horse-shoe Magnet to extract particles of Iron from the roasted ore, 5 inch, 1s. 6d.
- i. China Tray in which the roasted ore is mixed with water, 1s. 6d.

4628. APPARATUS for SATURATING the ORE with CHLORINE *as represented by* Fig. 4625

Consisting of Iron retort stand, tinned iron sandbath, spirit lamp, flask to prepare chlorine gas, wash bottle, cylinder to contain the pounded ore, condensing jar for excess of gas: with glass tubes and caoutchouc fittings of size to operate upon 2 or $2\frac{1}{2}$ lbs. of ore, price 16s.

If supplied with extra gas bottle and set of extra tubes, 18s.

4629. APPARATUS for EXTRACTING the CHLORIDE of GOLD and PRECIPITATING the GOLD.

- a. Set of Four Beaked Tumblers, 2s. 6d.
 - b. Glass Funnel, $2\frac{1}{2}$ inch, 3d.
 - c. 100 Circular Filters for ditto, 6d.
- The ring of the Stand in Fig. 4625 serves to support the funnel.
- d. Washing Bottle to wash the gold on the filter, 1s. 6d.
 - e. Two flasks for preparing solution of ferrous sulphate, 6d.
 - f. Porcelain Basin in which to dry the filter and precipitate, $2\frac{3}{4}$ in. wide, 4d.

4630. CHEMICALS REQUIRED for this PROCESS:—

- a. Manganese peroxide, per lb., $2\frac{1}{2}$ d.
- b. Sulphuric Acid, commercial, per lb., 2d.
- c. Hydrochloric Acid, commercial, per lb., 2d.
- d. Ferrous Sulphate (Iron Protosulphate), pure, per lb., 2s.

APPARATUS FOR METALLURGIC OPERATIONS.

4640. FURNACES for METALLURGIC OPERATIONS.

Consult the Section on the various methods of producing and applying Heat, commencing at p. 71; see in particular, the blast furnaces of Deville, No. 770, Sefstroe, No. 762, and Griffin, No. 1100.

11. CRUCIBLES REQUIRED by METALLURGISTS.

Consult the Section on Crucibles, commencing at page 136.

12. Crucibles, conical form, Fig. 4642, with spout, wrought iron, without covers, 4 inches deep outside, $3\frac{1}{2}$ inches deep inside, $2\frac{7}{8}$ inches across the mouth, thickness of metal $\frac{1}{6}$ inch, holds 8 ounces of water, 3s.



4642.



4643.

13. Crucibles, wrought iron, very stout, Fig. 4643, without cover, no spout, 4 inches high outside, $3\frac{1}{2}$ inches deep inside, $2\frac{1}{4}$ inches wide inside, thickness of metal $\frac{1}{4}$ inch, holds 6 ounces of water, 5s.

14. Mould for making Small Crucibles for the Assay of Iron Ores, and other Metallurgic Experiments. Accompanied by a second Mould for making Covers for the Crucibles. See Percy's Metallurgy, I., 228-230.

The Crucibles made by this mould are about 2 inches high by $1\frac{1}{4}$ inch wide. The use of the mould is fully described by Dr. Percy. The Crucibles serve for the assay of iron ores when only grains of ore are operated upon.

- 14a. Best make, solid Boxwood and Gun Metal, finely finished, *the pair of moulds*, 33s.

- 14b. Second Quality, made of Mahogany, and less finely finished, *the pair of moulds*, 16s. 6d.

15. Apparatus for Boring Cavities in the small crucibles when lined with charcoal. Preparation of *creusets brasqués*. Consisting of a pair of borers, see Percy's Metallurgy, I., 230, price 7s.

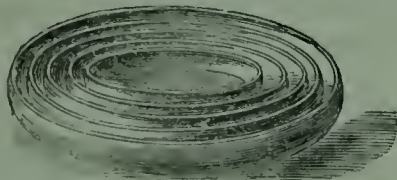
The Crucible is made by means of the apparatus No. 4644. It is filled with charcoal powder and with a little starch paste or treacle, and rammed in close. The hole is first cut with a borer using cutting edges, and it is then pressed with a round smooth borer, to give it an even surface.

16. Roasting Dishes, fireclay, English, Fig. 4646, price per dozen :—
 $2\frac{1}{2}$ inch, 3s. 3d. ; 3 inch, 3s. 9d. ; 4 inch, 4s. 6d. ; 5 inch, 5s.

17. The Set of Four Dishes, $2\frac{1}{2}$ to 5 inches, Fig. 4647, 1s. 6d.



4646.



4647.



4648.

18. Scorifiers, fireclay, English, Fig. 4648, price per dozen :—

1 inch to $1\frac{7}{8}$ inch, 1s. 6d.

2 inch to $2\frac{1}{4}$ inch, 2s.

$2\frac{1}{2}$ inch to $2\frac{7}{8}$ inch, 2s. 6d.

3 inch to $3\frac{1}{2}$ inch, 3s.

CRUCIBLE TONGS USED BY METALLURGISTS.

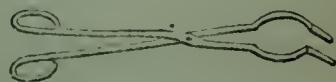
19. Consult the Section on Tongs at page 12 ; also those mentioned in the Section on Cupellation, page 386. The following are also useful :—

20. Crucible Tongs of the form of Fig. 4650, which either clip the crucible by the edge, or grasp it round the middle, the handles and as far as the hinge made of German silver, the prongs of iridium-platinum, 8 inches long, price 63s.

21. The same form in German Silver, 3s. 6d.

For other varieties of small Tongs, see page 12.

22. Crucible Tongs for lifting Crucibles of 4 inch size into and out of a Furnace, 26 inches long, elastic iron, Fig. 4652, 5s.



4650.

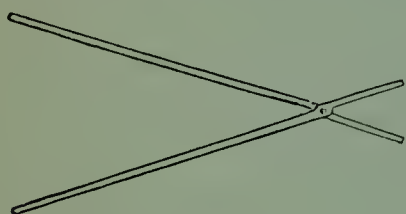
4653. Crucible Tongs for lifting Crucibles vertically, and pouring the metal from them, basket form, Fig. 4653; the basket, 3 inches, length 30 inches, 5s.



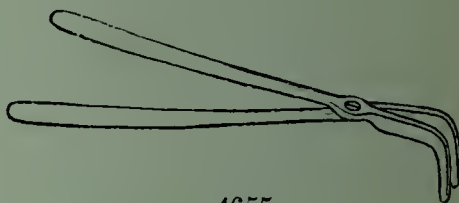
4654. Crucible Tongs for lifting Iron Crucibles, made with straight points, form of Fig. 4654, 27 inches long, 2s. 6d.

4655, Ditto with bent points, form of Fig. 4655, 27 inches long, 2s. 6d.

Larger and stronger Tongs are quoted at page 13.



4654.



4655.

4656. MORTARS and PESTLES, the varieties chiefly used by Metallurgists:—
Mortars, Iron, Bell-shaped, see page 5, No. 44.

Sizes required, 5 to 12 inches diameter.

Mortars, Iron, Hemispherical, see page 5, No. 45.

Size required, 5 or 6 inches diameter.

Mortars, Porcelain, see pages 6 to 8.

Sizes required, between 4 and 6 inches diameter.

Mortars, Steel, for Crushing Minerals, see page 5, No. 49.

Mortars, Agate, see page 6, No. 52.

4657. IRON MOULDS for CASTING INGOTS.

When used, the Moulds should be made hot, slightly greased inside, and sifted over with charcoal dust. This prevents the adhesion of the fused metal to the mould.

4658. Ingot Mould, form of Fig. 4658, with two hemispherical holes, each $1\frac{3}{4}$ inch diameter, and 1 inch deep, turned smooth, 3s.

4659. Ingot Mould, with long arm and wood handle, Fig. 4659, 4s. 6d,

4660. Ingot Mould, form of Fig. 4659, but with longer metal handle and wood two holes, each $2\frac{1}{8}$ inch diameter and $\frac{7}{16}$ inch deep, turned smooth, 5s.



4658.



4659.



4661.

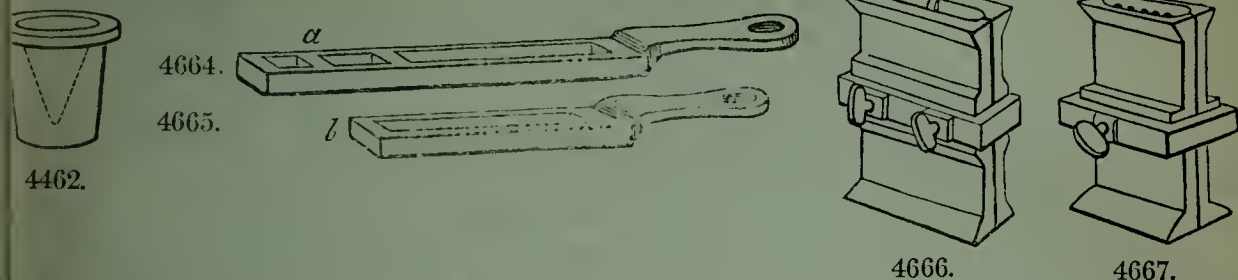


4663.

4661. Ingot Mould, Conical form, Fig. 4661, depth inside $3\frac{1}{2}$ inches, diameter at mouth, $1\frac{3}{4}$, at bottom $\frac{3}{4}$ inch, 4s.

4662. Ingot Mould, form of Fig. 4662, for producing small cones, size of cone 2 inches diameter, 2 inches deep, 3s. 6d.

663. Ingot Mould for Small Bars, Fig. 4663, size of cavity $4\frac{1}{4}$ inch long, $1\frac{1}{2}$ inch wide, $\frac{1}{2}$ inch deep, 1s.
664. Long Ingot Mould, in Three Divisions, 1 by $\frac{3}{4}$ inch, $1\frac{1}{2}$ by $\frac{3}{4}$ inch, $5\frac{1}{4}$ by $\frac{3}{4}$ inch, all $\frac{1}{2}$ inch deep, with handle, Fig. 4664, 1s. 6d.
665. Long Tin Assay Mould, for producing a Slab of Tin, of semi-cylindrical form, measuring $6\frac{1}{4}$ inches long, $\frac{3}{4}$ inch wide, $\frac{3}{8}$ inch thick, Fig. 4665, 1s. 6d.



666. Ingot Mould for producing flat slabs of metal, mould of the form of Fig. 4666.
two pieces, secured together by a collar and screw, the inside filed smooth,
Two sizes :—

- 666*a*. For Slabs of metal measuring 4 inches long, $1\frac{1}{4}$ inch wide, $\frac{1}{16}$ inch thick, 8s.
 666*b*. For Slabs of metal measuring 5 inches long, $1\frac{3}{8}$ inch wide, $\frac{1}{4}$ inch thick, 9s.
 667. Iron Moulds for casting narrow rods of caustic potash, pure zinc for Marsh's Apparatus, &c. The cavities measuring $\frac{1}{16}$ inch in width; the mould in two pieces, connected by a collar with screws, as represented by Fig. 4667, or the larger sizes by Fig. 4666, the metal filed smooth inside, rough outside.

- a.* For 3 Rods of 3 inches, 6s. 6d.
b. For 6 Rods of 3 inches, 8s.
c. For 12 Rods of 3 inches, 10s.
- d.* For 18 Rods of $3\frac{1}{2}$ inches, 14s.
e. For 24 Rods of $3\frac{3}{4}$ inches, 18s.

68. Gun Metal Mould of the same description, filed smooth both within and without, to produce 3 rods, 12s.

69. MISCELLANEOUS INSTRUMENTS and TOOLS.

370. Iron Slab, 12 inches square, $1\frac{1}{2}$ inch thick, smooth top, planed, 24s.
 371. Plumber's Scraper, for cleaning the surface of metals, with handle, 1s. 6d.
 372. File, with float cut, for rasping metals without becoming choked, 1s. 6d.
 373. Scratch Brush, for cleaning buttons of metal, 1s. 6d.
 374. Copper Assay Scoops, length 10 inches, greatest width
 4 inches, width at mouth $1\frac{1}{4}$ inches, 5s. 6d.
- 



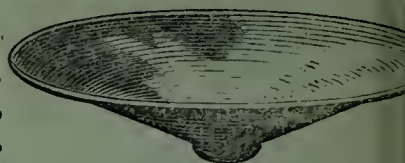
75. Copper Flux Spoon, figure 4675, 1½ inch long, 1 inch wide, ebony handle, 2s.
 2 ditto. 1 ditto. ditto. 2s.

76. Sieves : see page 8.
77. Sieves, a set of six, wooden sides, copper bottoms, diameters from 6 to 12 inches, apertures 6, 13, 25, 40, 60, and 80 to the inch, *the set*, 24s.
78. Box Sieve, 8 inches in diameter, with three divisions, size of gauze bottoms 100, 50, and 30 meshes to the lineal inch, with cover, see fig. 71, 4s. 6d.
79. Magnifying Lens, of three powers (for the pocket), for examining Crystals, Minerals, &c. See Nos. 4434, 4s., and 4435, 8s. 6d.
80. Shears for cutting Lead, &c. See No. 142.
81. Steel Anvils (Stakes) for crushing Minerals and flattening Beads of Silver, see page 2.
82. Massive Anvil, weight 28lb., 30s.
83. Hammer, square face, for breaking Crucibles after a fusion, 2s.

4684. Steel Slice, for cutting the fused assay out of an iron crucible, 30 inch long, 3s.

4685. Gold-washing Basin, of stout Zinc, form of figure 2685, 26 inches diameter, 15s.

4686. APPARATUS FOR GENERAL USE IN ANALYSIS:— Spirit Lamps, Furnaces, Flasks, Beakers, Test Glasses, Baths, Filtering Apparatus, Evaporating Basins, Retorts and Receivers, Hydrometers, Stills, Gas Bottles, and other analytical apparatus, will be found under their respective heads in this work.



2685.

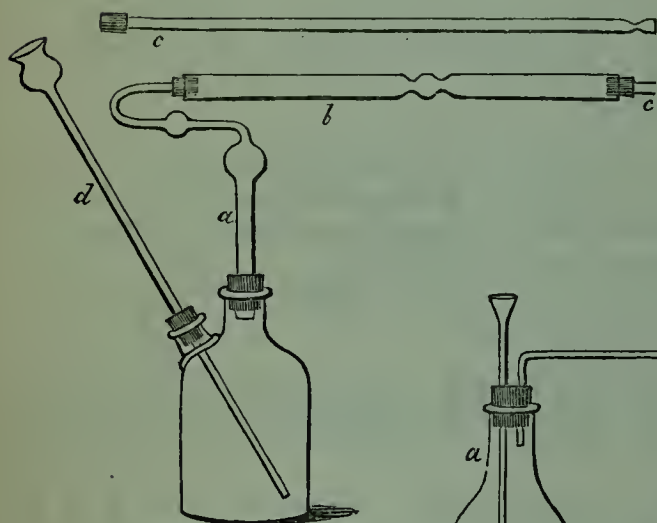
4687. APPARATUS AND TEST SOLUTIONS FOR VOLUMETRIC ANALYSIS. See page 280.

4688. BLOWPIPE APPARATUS. See page 351.

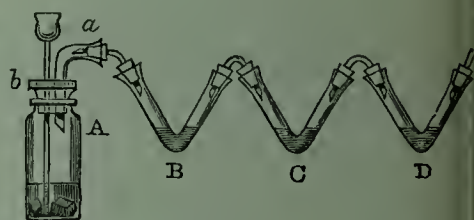
4689. CHEMICALS REQUIRED FOR ASSAYING. The prices of the chemicals cannot be stated, as they change daily, and depend not only on the market price, but on the quantity demanded:—

Bone Ashes.
Pure Lead.
Carbonate of Soda.
Refined Nitre.
Borax.
Litharge.
Lead in foil.
Fire Clay, for Luting.

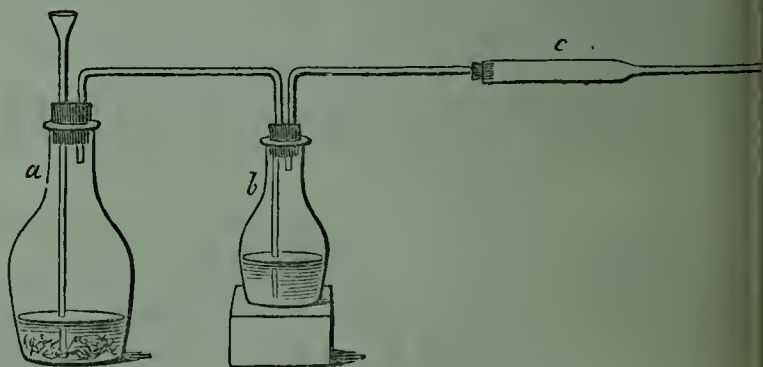
Cream of Tartar.
Red Argol.
Sal Ammoniac.
Carbonate of Ammonia.
Chlorate of Potash.
Fluorspar.
Black flux.
White flux.



4709,



4710.

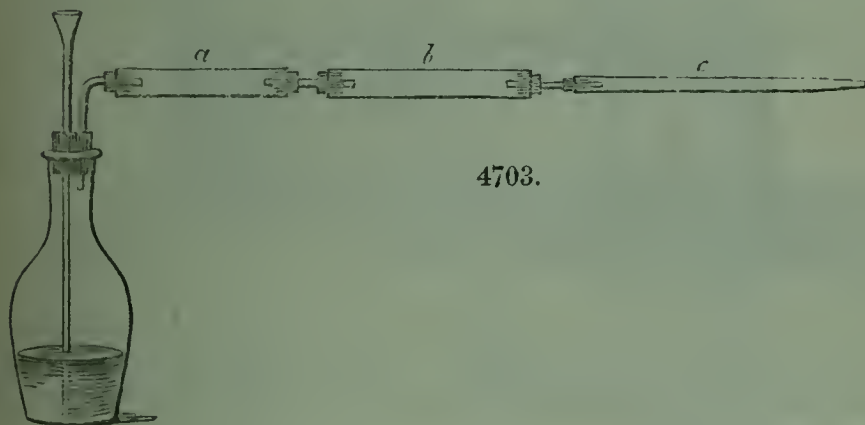


4708.

APPARATUS FOR THE DETECTION OF ARSENIC, DESCRIBED AT PAGE 396.

Marsh's Arsenic Test.

700. Marsh's Arsenic Apparatus, for the detection of Arsenic contained in solutions of organic matter; consisting of a tube with two bulbs, fitted upon a mahogany stand, with brass stopcock and jet complete, Figure 4700, 6s.
701. The Two-bulb Glass Tube, without fittings, 2s.
702. White Biscuit Porcelain plate, for receiving the deposit of metallic Arsenic, when arseniuretted hydrogen gas is burnt at Marsh's jet.
a, 3 inches by 2 inches, 6d. *b*, 4 inches by 3 inches, 1s.



4703.



4700.

703. Berzelius's Apparatus for the decomposition of sulphide of arsenic by heating it with carbonate of soda in a current of dry hydrogen gas. Size of flask about 30 ounces, length of tubes *a*, *b*, *c*, about 30 inches, 5s.

The mixture of sulphide of arsenic with dry carbonate of soda, is loosely fitted into a slight glass tube, and that is pushed into the tube *c*. The tubes *a* and *b* are to contain substances to dry and purify the hydrogen gas.

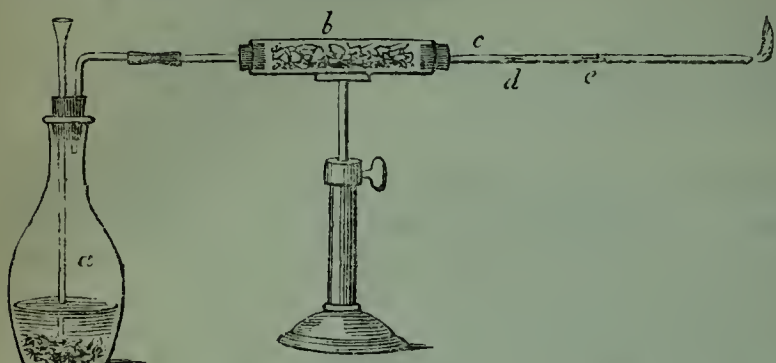
704. Fresenius's Apparatus for reducing Sulphide of Arsenic, comprising a gas bottle for hydrogen gas, a chloride of calcium tube, and a hard glass jet, arranged as represented by Fig. 4704, 4s.

The stand is priced at page 33.

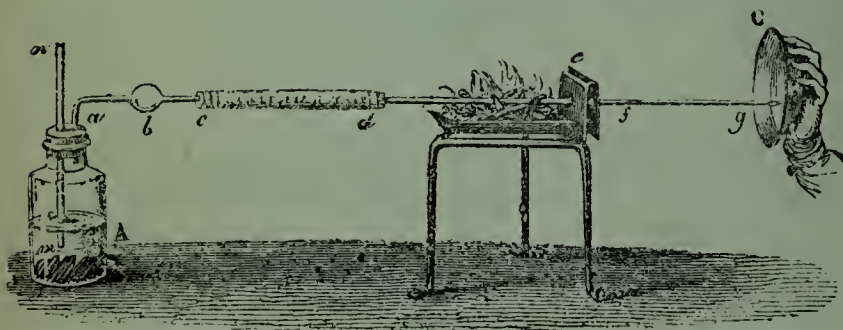
a is a gas flask, *b* a tube containing chloride of calcium, *c* a hard glass tube in which, at the point *d*, placed a glass splinter containing a mixture of sulphide of arsenic and carbonate of soda. The apparatus is filled with pure hydrogen gas, the point *d* is gently heated to expel moisture, and then suddenly a very strong heat, such as that of a blowpipe, is applied to *d*, whereupon a metallic mirror of arsenic is produced at *e*.

705. REGNAULT'S Modification of Marsh's Arsenic Apparatus, figure 4705. Price of the Gas Bottle, with the tubes *a*, *b*, *c*, *d*, *f*, and the iron screen *e*, 5s.
706. Mitscherlich's Modification of Marsh's Apparatus, figure 4706, with 6 copies of the tube *e*, 8s.
707. Extra copies of the Pipette *a* (wide branch 10 by $\frac{3}{4}$ inches), figure 4706, 1s.

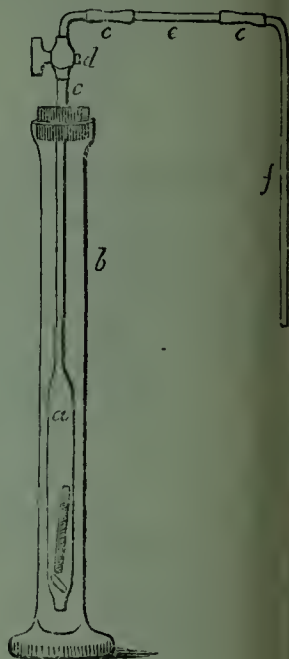
The pipette *a* contains a rod of pure zinc, retained in its place by a spiral of copper wire, *b* a cylinder that contains the solution to be tested, filled up to the neck of the pipette; *c, c, c*, three caoutchouc connectors, *d* a brass stopcock with an elbow piece; this is secured to the tubes *a* and *e* by caoutchouc connectors, to admit of separation for cleaning for each operation; *e* a hard glass tube of 12 inches in length, in which the gas is decomposed by the application of external heat; *f* a tube which dips into water, to cut off atmospheric air. The arsenic should be collected in several copies of the tube *e*.



4704.



4705.



4706.

4708. Fresenius and Von Babo's Arsenic Apparatus, for decomposing arsenious acid or sulphide of arsenic, by heating it with a mixture of cyanide of potassium and carbonate of soda, in a current of dry carbonic acid gas, Fig. 4708, page 394, price 5s.

a, is a large flask to prepare the gas; *b*, wash bottle containing oil of vitriol to dry the gas; *c, c, c*, tube containing the arsenical mixture. See Fresenius on Qualitative Chemical Analysis, page 119.

4709. Otto's Modification of Marsh's Arsenic Apparatus, figure 4709, page 394, size of flask about 1 pint, each horizontal tube about 12 inches long, the set, 10s.

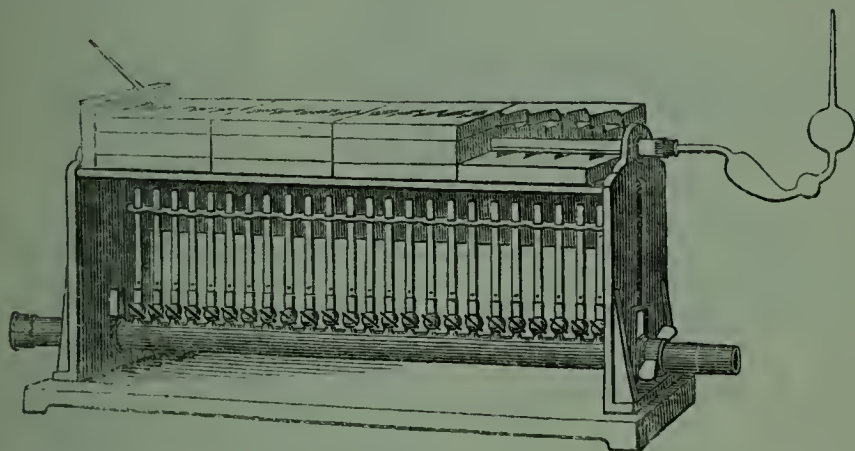
The use of this apparatus is described in Fresenius's Qualitative Analysis, page 116. It serves like No. 4704, to reduce sulphide of arsenic, but with the additional advantage of preventing the mistaking of antimony for arsenic.

4710. CLARK'S ARSENIC APPARATUS, consisting of a gas bottle, pint size, and bent tubes and connectors, fitted complete, fig. 4710, page 394, 6s. 6d.

When Arsenic is sought for by Marsh's process in mixtures containing organic matter, an excessive frothing often spoils the experiment. To prevent this, Professor CLARK separates the arsenic by this Apparatus. *A*, is a bottle for preparing hydrogen gas; *B, C, D*, three bent glass receivers connected by bent glass tubes and corks. *A*, contains pure zinc and pure hydrochloric acid, no stronger than 12° (= sp. gr. 1.03). *B*, contains a solution of caustic potash; *C*, a solution of acetate of lead; *D*, a solution of nitrate of silver. When it is proved that hydrogen gas passes through the V-tubes without action, the arsenical liquor is poured into the bottle *A*, by the funnel *b*. The great size of this bottle permits the frothing to occur without damage. The arseniuretted hydrogen gas passes through the receivers. In *B* it deposits sulphuretted hydrogen, and other impurities. In *C* it produces no action, if the washing in *B* is sufficient; that is, if the hydrochloric acid is not too strong, so as to force the operation too rapidly. In *D* it throws down metallic silver, and the arsenic remains in solution. When the current of gas ceases, the liquor in *D* is mixed with hydrochloric acid to throw down the excess of silver, and the liquor is filtered and evaporated to dryness. The product is *pure arsenic acid*, which can be submitted to its appropriate tests.

Organic Analysis.

10. GRIFFIN'S GAS COMBUSTION FURNACE. Fig. 4720. The details of this Furnace are given at page 103. The furnace represented by Fig. 4720 is of the size commonly used for nitrogen analyses. It measures 17 inches in length within the upright ends, and has 24 Bunsen's burners. Price £3 15s.



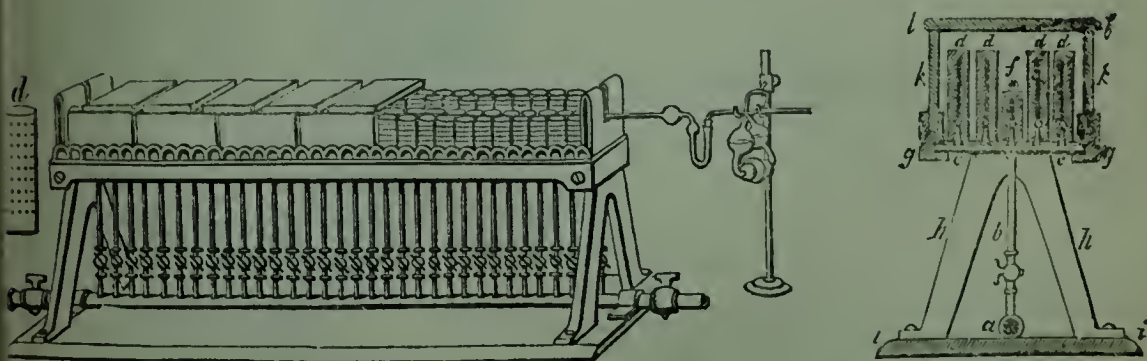
4720.

Furnaces of this construction of the following sizes are usually kept in stock.

See page 103.

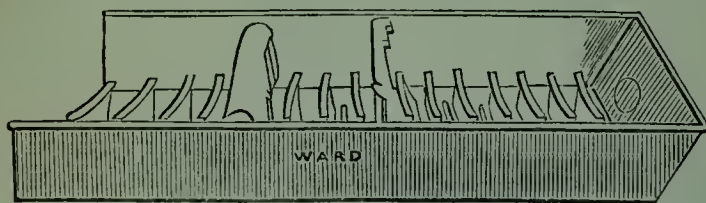
No.	Inside Length.	No. of Burners.	Price.
1079.	30 inches.	42 burners.	£6 6s.
1080.	25 „	36 „	£5 5s.
1081.	21 „	30 „	£4 10s.
1082.	17 „	24 „	£3 15s.
1083.	13 „	18 „	£3 3s.

11. HOFFMANN'S GAS COMBUSTION FURNACE. Consult the section at page 100, where several sizes of this furnace are described.



4722.

4723. Hoffmann's Gas Combustion Furnace for use when oxygen gas is required complete the combustion. See page 101, £3 10s.
4724. COMBUSTION FURNACE, FOR USE WITH CHARCOAL. This furnace, in the form originally used by Liebig, is represented by Figs. 4743 and 4743 *a*. The improvements of Stenhouse are in some measure represented in Fig. 4724. They consisted partly in turning over the tops of the slips of metal that form the tube supports, and increasing their number, and partly in regulating the draught of the grate by increasing the number of openings and diminishing their size, *price of the improved furnace, 24 inches long, made of stout sheet iron, 4s.*
4725. Charcoal Tongs, see No. 120. A handy sort is the 16 inch, price 1s. 9d.
4726. Fireclay Chauffer for bringing charcoal to a red heat, to feed the combustion furnace, No. 805, 7 inches diameter, 8s.



4724.



4728.



4735.

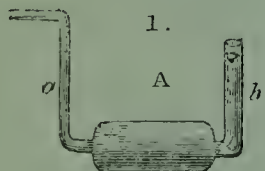
4727. Chimney or Blower, to raise the heat of the chauffer, No. 797, 2s.
4728. MORTARS AND PESTLES, broad and shallow form, with spouts, glazed inside with glazed pestle. Fig. 4728.

No. 3. Semi-Porcelain, $4\frac{1}{4}$ inches diameter, 2s.
 „ 4. „ „ 5 „ „ 2s. 3d.
 „ 6. Dresden Porcelain, 5 inches diameter, 3s. 6d.
 „ 7. „ „ 4 „ „ 2s. 9d.

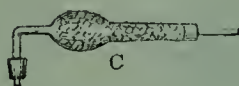
They may be had *unglazed* at the same prices.



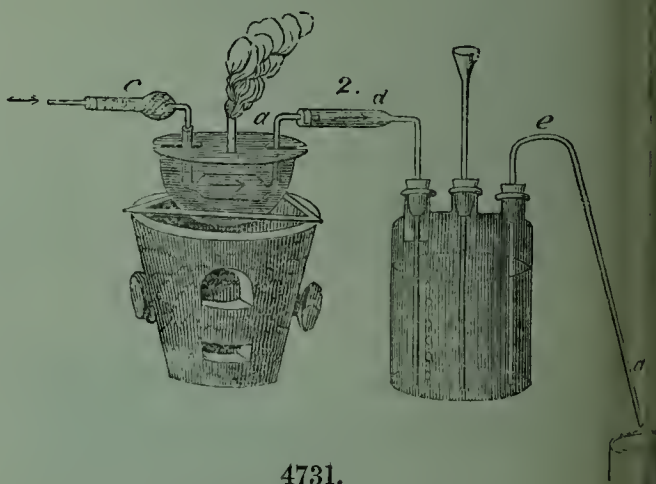
4729.



4730.



4734.

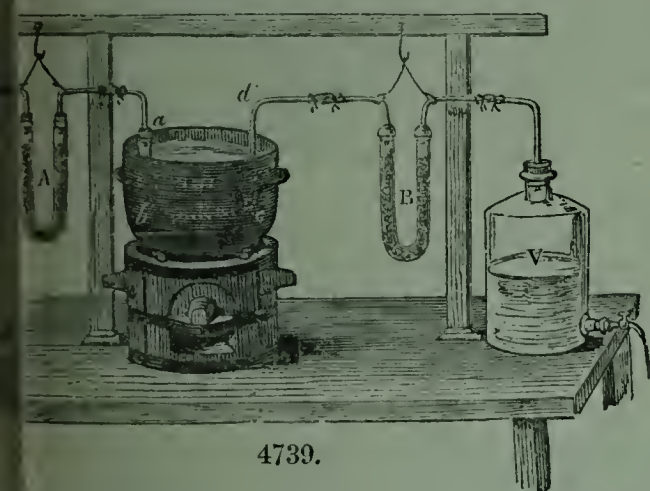


4731.

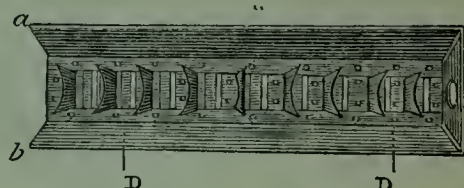
4729. Glass Tube in which to weigh the substances to be analysed, Fig. 4729, 1s.
4730. Drying Tube, namely, a bent tube in which organic bodies may be dried by placing the tube in a hot-bath of oil or water, and passing dry gas through the tube, form of Fig. 4730 and *a* Fig. 4731, 9d.

31. Bath for the Drying Tube, Fig. 4731. This consists of the following articles:—
 32. Iron Bath, such as No. 1227, 9 inch wide, $4\frac{1}{2}$ inch deep, price 1s. 6d., or No. 1226, 8 inch or $\frac{3}{4}$ gallon, price 1s.
 33. Chauffer for charcoal, No. 806, 9s., or a Gas Furnace, No. 982, price 12s.
 34. Bent Chloride of Calcium Tube of large size, for drying air, Fig. 4734, and *c*, Fig. 4731, 8d.
 35. Bent Chloride of Calcium and connecting tube, form of Fig. 4735, and *d*, Fig. 4731, 6d.
 36. Plain Syphon, *e a*, Fig. 4731, 8d.
 37. Long Funnel, 18 inch, Fig. 4731, 4d.
 38. Woulff's Bottle, 3 necks. See prices at page 151. Instead of a Woulff's Bottle any other form of Aspirator may be used. See page 22.
 39. Regnault's Apparatus for Drying Organic Substances previous to Analysis, as represented by Fig. 4739, consisting of one aspirator, two chloride of calcium tubes, and a bent tube, containing the organic body immersed in an iron water-bath, placed on a trivet over a furnace, the whole connected by glass and caoutchouc tubes, with two mahogany crook supports, 21s.

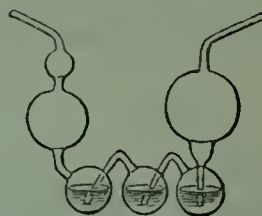
The prices of the articles separately, and of various sizes, may be found at the following places:—
 Chloride of Calcium Tubes, No. 2048; the Support, No. 398; the Aspirator, No. 250; the Drying Tube, No. 4730; the Chauffer and Bath, as referred to in the preceding article, Nos. 4732, 4733; D, Fig. 4755 represents another form of drying bath, which is heated by a spirit lamp.



4739.



4743 a.



4744.

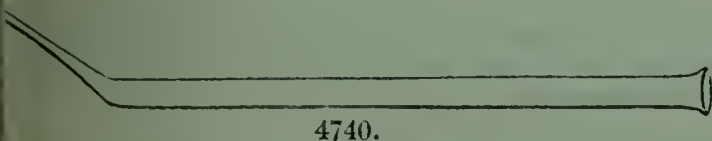
40. COMBUSTION TUBE, being that part of the apparatus in which the organic substance is ignited with oxide of copper, or other oxidating substances, form of Fig. 4740, white Bohemian glass, of the most infusible quality, prepared for use:—

12 inch, 6d.

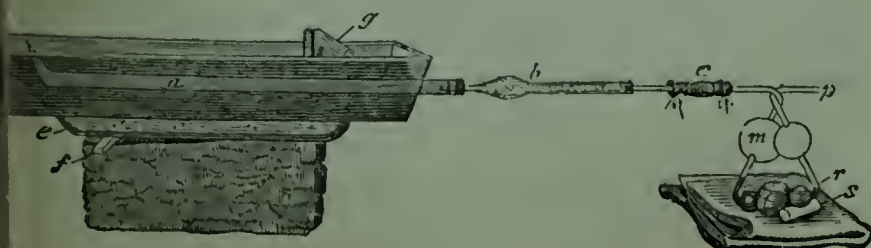
16 inch, 8d.

20 inch, 9d.

30 inch, 1s.



4740.



4743.



4745.

4741. Combustion Tube in lengths of from 3 to 4 feet, and of $\frac{1}{2}$ inch, $\frac{5}{8}$ inch, a $\frac{3}{4}$ inch bore.

1 lb. at 1s. 4d.

20 lb. at 1s. 2d.

50 lb. at 1s.

Purchasers are requested to state on their orders which BORE of tube they wish to have. page 21.

4742. Brass Wire Gauze to wrap round the tube to prevent its flexure at a high temperature, per square foot, 1s. 6d.

4743. Liebig's Potash Apparatus, with 5 bulbs, used to contain a solution of caustic potash, to absorb the carbonic acid produced during the combustion of organic body. See Fig. 2213, and *m, r*, Fig. 4743, *packed in a paper box*, 1s.

4743 *a*. In Fig. 4743, the apparatus for organic analysis is arranged in order for a combustion. It embraces the Furnace, No. 4724, a Combustion Tube, No. 4740, a Chloride of Calcium Tube, No. 4747, a Caoutchouc Connector, No. 4751, and the Potash Bulbs, No. 4743.

4744. Potash Apparatus, Geissler's form, Fig. 4744, which stands steadily on 3 bulbs so connected together, as to ensure the effectual absorption of the gas without danger of the liquor running back into the combustion tube, 2s.

For other forms of Potash Bulbs, see articles on the absorption of gases, commencing at No. 21 page 243.

4745. Suction Tube, for filling the Bulb Apparatus with solution of caustic potash. Fig. 4745, 4d.

4747. Chloride of Calcium Tube, for absorbing the water produced during a combustion, form of Fig. 4747, and *b*, Fig. 4743, of light German glass tube, the wide tube measuring 4 inches by $\frac{3}{8}$ inch, 2d.

4748. Ditto, larger size, the wide tube measuring $5\frac{1}{2}$ inches by $\frac{1}{2}$ inch, 3d.



4747.



4749.

4749. Chloride of Calcium Tube, with an extra bulb to condense part of the water produced before it reaches the chloride of calcium, form of Fig. 4749, 6d.

4750. Marchand's Chloride of Calcium Tube, form represented by Fig. 4750, 1s.

For other forms of chloride of calcium tubes, see Nos. 2048 to 2059, page 225.

4751. Caoutchouc Tubes for connecting together the various pieces of glass apparatus. The proper sort is the narrow vulcanised tubes, described No. 1953.

In Figs. 4743, 4739, &c., these tubes are represented as being tied with strings. The reason is that the wood-cuts of those figures were engraved before the invention of vulcanised caoutchouc. When the latter is properly chosen, tying is unnecessary.

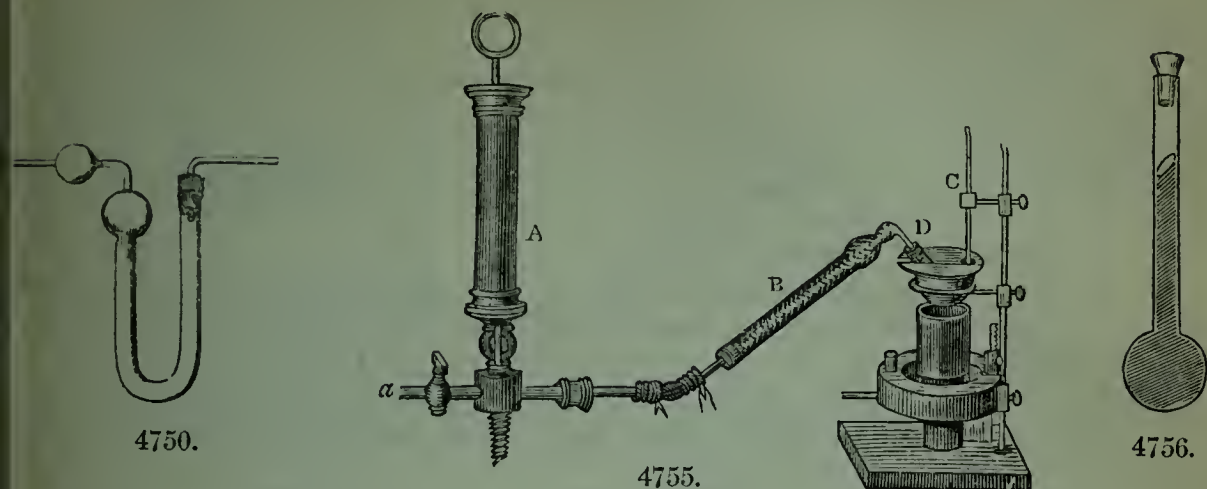
4752. Corks for closing the Combustion Tube. See No. 168.

4753. Caoutchouc Stoppers. See No. 193.

4754. Apparatus for heating Oxide of Copper to redness, to render it perfectly dry. The Gas Furnace, No. 994, answers this purpose perfectly. In less than half an hour a $4\frac{3}{4}$ inch clay crucible, filled with oxide of copper, can be heated by it to full redness.

4755. Air Pump or Syringe for exhausting air from glass tubes, as represented by Fig. 4755. See No. 736 in this list.

36. Large Bulb Tube, in which ignited oxide of copper may be cooled, and from which it can be transferred to the combustion tube, Fig. 4756, 4d.



37. Boat-shaped Trays of Porcelain or Platinum, for use when organic substances are burnt in a current of gaseous oxygen. See No. 1380.

3758. Apparatus for determining the relative volumes of Nitrogen and Carbonic Acid gas produced by the combustion of an organic body; consisting of a Combustion Furnace, No. 4724, a Combustion Tube, No. 4740, the Pneumatic Mercury Trough, No. 2089, and a Graduated Glass Tube. The latter should be about 12 inches long and $\frac{1}{2}$ inch in width, graduated to cubic centimetres or cubic inches, as may be desired. See Nos. 2331 and 2326. Six or eight such tubes are required for an analysis of this description.

3759. Apparatus for discriminating Nitrogen from Carbonic Acid in a gaseous mixture, by absorbing the latter with solution of Caustic Potash. See Fig. 4759. Fig. 4759, is a tall glass mercury trough, No. 2099. B is one of the tubes described under No. 4758. β is a pipette by which the solution of caustic potash is passed through the mercury trough into the mixed gases. This pipette is shown at large by Fig. 4760.

380. Potash Pipette, Fig. 4760, 6d.

381. Three-limbed or T-shaped Tube, used in the direct determination of Nitrogen, namely, for connecting the Combustion Tube at the same time to the air syringe and by a gas-leading tube to the pneumatic trough. Fig. 4761. 6d.

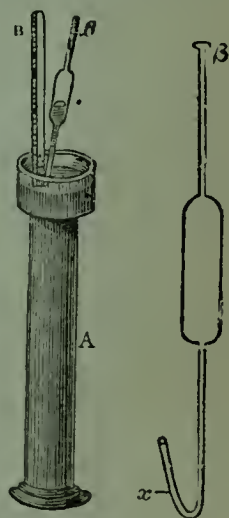
382. Apparatus for determining Nitrogen quantitatively, Fig. 4762.

383. Graduated Gas Tube, B Fig. 4762, about 18 inches long, and 1 inch or $1\frac{1}{8}$ inch bore, the glass $\frac{1}{10}$ inch in substance, graduated to show about 280 centimeter cubes, 12s. 6d.

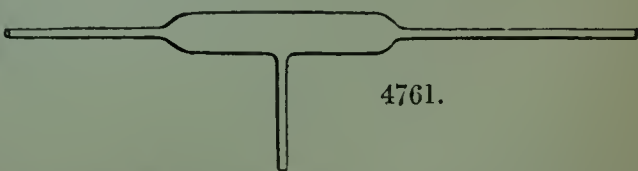
384. The same, capacity about 16 or 17 cubic inches, graduated to show $\frac{1}{10}$ cubic inch, 12s. 6d.

385. Gas leading Tube, U form, C Fig. 4762, for use with the above apparatus, 39 inches long, 8d.

386. Will and Varrentrapp's Apparatus for the determination of Nitrogen, by converting it into Ammonia, and collecting the Ammonia in Hydrochloric Acid, form of the Apparatus, Fig. 4766, thin hard German glass, 8d.



4759. 4760.

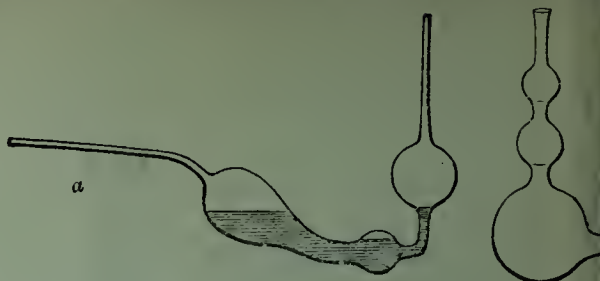


4761.

4767. Apparatus for the Collection of Nitrogen disengaged during the combustion of organic bodies, after the method of Simpson; glass receiver of the form of Fig. 4767, 1s. 6d.

The use of this apparatus is described by Dr. Simpson, in the *Quarterly Journal of the Chemical Society*, 1854, vol. vi. p. 289.

4768. Specific Gravity of Vapours, determination after the method of Dumas. Very light Flasks of thin German glass, suitable for this experiment; the bulb about inches diameter, with a long narrow bent neck, 1s. 6d.



4766.

4767.

4769. CLOEZ'S APPARATUS FOR COMBUSTIONS IN ORGANIC ANALYSIS.

In this apparatus the combustion is effected in a wrought iron tube, which is 45 inches long, about $\frac{1}{4}$ inch in bore. When heated, about 8 inches of it is allowed to project from each end of furnace. That leaves 29 inches in the furnace.

The description of Tube is that described at page 144 of this work, and a suitable Furnace heating it is that described at No. 1065.

A description of the mode of conducting an Organic Analysis with this apparatus is given in *Annal. de Chim. et de Phys.* sér. III. 68, 39 $\frac{1}{2}$. Also in Fresenius's *Anleitung zur Quantitat. Chemischen Analyse*, 1862, page 619.

4770. PURE CHEMICALS USED IN ORGANIC ANALYSIS:—

Oxide of Copper, per lb., 7s. 6d.

Ditto, *dense*, per lb., 8s. 6d.

Chromate of Lead, pure, fused, per lb., 7s.

Soda-Lime, per lb., 3s.

Bichromate of Potash, cryst. per lb., 3s.

Canstic Potash, partially purified, per lb., 3s. 6d.

Chloride of Calcium, crude, dried, per lb., 2d.

Chloride of Calcium, fused, per lb., 6d.

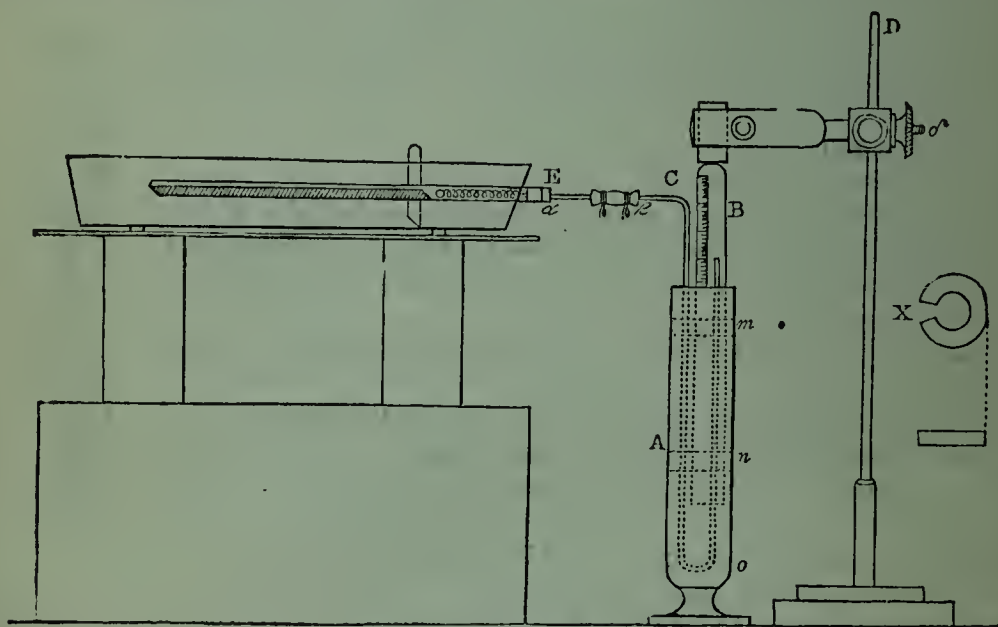
Chlorate of Potash, cryst. per lb., 2s.

Copper, in fine filaments, per lb., 6s.

Copper Turnings, per lb., 2s.

Copper Foil, per lb., 4s.

Asbestos, in long white filaments, per lb.,



4762.

Collections and Cabinets of Chemical Apparatus.

In order to facilitate the comparison of the numerous details given in the following specifications, the collections of Instruments have been arranged in GROUPS, according to the purposes for which they have been prepared. The numbers prefixed to the names of the Instruments refer to those numbers in CHEMICAL HANDICRAFT, in which FIGURES or DESCRIPTIONS of the Instruments will be found.

GROUP I.—*Collections of Apparatus for Amateurs, or for those beginning the study of Chemistry, Nos. 4780 to 4785.*

80. APPARATUS and PREPARATIONS for performing ELEMENTARY EXPERIMENTS in CHEMISTRY, arranged in Portable MAHOGANY CABINETS. THREE SIZES—at 16s., 31s. 6d., and 52s. 6d.

These CABINETS have been prepared to suit the wants of the student of Chemistry, who wishes to possess the means of performing the experiments he witnesses at lectures, or finds described in books. They have been arranged with a view to practical utility, and are not mere toys. The articles they contain are of the best materials and construction, and selected with due regard to their adaptation to one another, and to their general utility. Even the cheapest collection (at 16s.) affords the apparatus and materials for trying an extensive range of interesting experiments; while the more expensive collections, besides enabling the student to demonstrate the fundamental facts of Chemistry, provide him with the apparatus and tests necessary for an effective course of qualitative analysis. Every article contained in these Cabinets is fully described in Griffin's "Chemical Recreations," which also contains those instructions on Chemical Manipulation, which are necessary to enable the beginner to perform his experiments with safety and certainty of success. The following articles, required by the Experimental Chemist in large quantities, could not have been included in the Cabinets without greatly increasing their bulk and price. They have therefore been omitted:—Distilled Water, Sulphuric Acid, Hydrochloric Acid, Nitric Acid, Ammonia. These may be obtained of any Chemist and Druggist.

Separate Chests are prepared, containing Stoppered Bottles filled with Acids, Ammonia, &c., of the purest commercial or pure, suitable to any of the Laboratories.

Also, Collections of Stoppered Bottles, containing Solutions of all the principal Reagents in a state of purity. See No. 4809.

81. PORTABLE CHEMICAL CABINET, in MAHOGANY, *price* 16s.

CONTENTS.

89. Retort Stand, one ring	1800. Porcelain Capsule, No. 5
92. Pestle and Mortar, No. 00, $2\frac{1}{4}$ inch	1626. Glass Funnel, $1\frac{1}{4}$ inch, No. 1
91. Glass Spirit Lamp, 1 oz.	1626. 100 Paper Filters to fit it, No. 1
90. Glass Flask, 1 ounce	2410. Conical Test Glass, 1 oz.
90. Glass Flask, 2 ounces	1785. Watch Glass, $1\frac{1}{2}$ inch
90. Test Tubes, 3 by 1, and 3 by $\frac{3}{4}$ inch	1790. Capsule with handle, $1\frac{1}{2}$ inch
90. Test Tubes, 4 by 1, and 5 by $\frac{5}{8}$ inch	2423. Book of Litmus Paper
90. Open Glass Tubes, $\frac{1}{2}$ and $\frac{1}{4}$ inch	2423. Book of Turmeric Paper
95. Glass Stirrers, 3 and 6 inch	92. Iron Spoon for fusions
90. Glass Pipette, 6 inch	1616. Two Slips of Glass, 4 by 1 inch
93. Porcelain Basin, No. 00, $2\frac{3}{4}$ inch	2437. Test Metals, Fe, Cu, Zn
93. Porcelain Crucible and Cover, No. 00	864. Cotton Wick for Lamp

Continued on page 404.

4781. PORTABLE CHEMICAL CABINET, *price 16s., continued—*

CHEMICAL PREPARATIONS, CONTAINED IN 9 CORKED BOTTLES AND 24 PAPER BOXES:

Alum	Galls, Tincture	Potassium, Sulphate
Ammon. Carbonate	Iron, Sulphate	Silver, Nitrate, <i>solution</i>
Ammon. Oxalate	Lead, Acetate	Sodium, Borate
Antimony, Sulphide	Manganese, Peroxide	— Carbonate
Barium, Chloride	Potass. Bichromate	— Phosphate
Boracic Acid	— Binoxalate	Strontium, Nitrate
Bleaching Powder	— Carbonate	Sulphur
Cobalt, Chloride	— Chlorate	Tartaric Acid
Copper, Nitrate	— Ferroeyanide	Tin, granulated
Copper, Sulphate	— Hydrate	— Protochloride
Fluorspar	— Nitrate	Zinc granulated



4782.

4782. PORTABLE CHEMICAL CABINET, in MAHOGANY, represented by F
4782, *price 31s. 6d.*

CONTENTS.

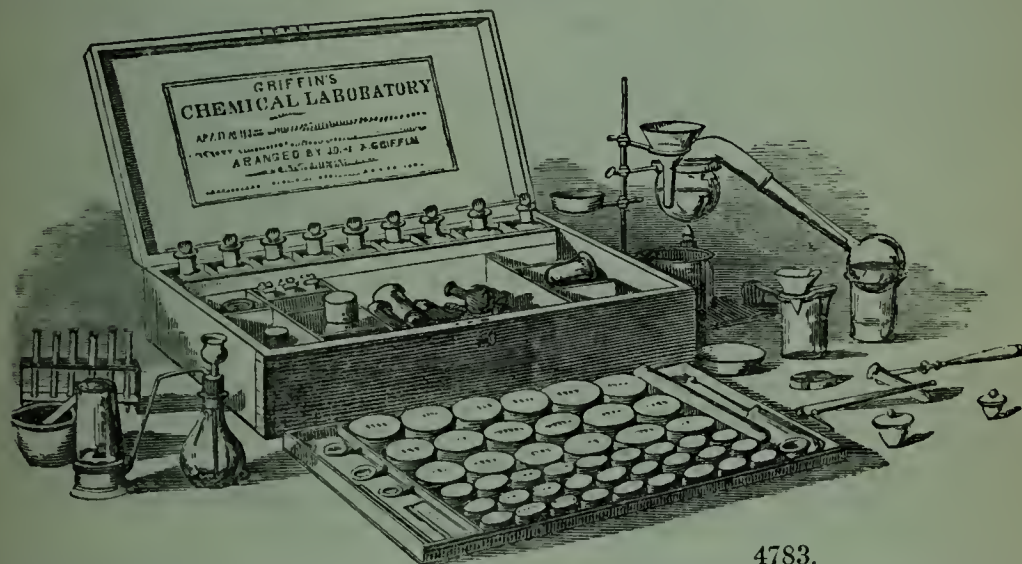
289. Retort Stand, one ring	1626. Funnel, No. 2, $1\frac{1}{2}$ inch
62. Porcelain Mortar and Pestle, 00	1626. Filters for ditto, $2\frac{3}{4}$ inch (100)
851. Glass Spirit Lamp, 1 oz.	1626. Funnel, No. 1, $1\frac{1}{4}$ inch
864. Cotton Wick, 3 feet	1626. Filters for ditto, $2\frac{1}{4}$ inch (100)
4201. Blowpipe	2410. Clark's Test Glass
4270. Platinum Blowpipe Wire	2423. Book of Litmus Paper
4277. Platinum Foil	2423. Book of Turmeric Paper
92. Iron Spoon for Fusions	2437. Test Metals, Fe, Cu, Zn.
98. Albata Test Spoon	115. Stirrers, one each 3 and 6 inch.
1442. Set of 3 Beaker Glasses	1610. Filtering Ring, 2 arms
1400. Glass Flask, 3 ounce	1690. Straight Pipette, 6 inch
1419. Bulb Tube, No. 3	4360. Open Glass Tubes, $\frac{1}{8}$ to $\frac{1}{4}$ inch (4)
2400. Test Tubes, 3 by $\frac{1}{2}$, 4 by $\frac{3}{8}$ inch	387. Tube Holder with Handle
2400. Test Tubes, 4 by 1, 5 by $\frac{1}{2}$ inch	1323. Porcelain Crucible, No. 0
2400. Test Tubes, 2 by $\frac{1}{4}$ (3)	1743. Porcelain Basin, No. 0
4365. Berzelius's Bulb Tube (2)	1798. Porcelain Cup, No. 1
1785. Watch Glass, 2 inch	1798. Ditto. No. 3
1790. Porcelain Capsule and Handle (2)	1798. Ditto. No. 6

FIFTY CHEMICAL PREPARATIONS, contained in 4 stoppered $\frac{1}{4}$ ounce glass bottles, 4
corked $\frac{1}{2}$ ounce bottles, 14 half-ounce wooden boxes, and 22 quarter ounce
paper boxes, as follows:—

Continued on page 405.

82. PORTABLE CHEMICAL CABINET, *price 31s. 6d., continued—*

Ammon., Carbonate	Iron, Sulphate	Potassium Ferrideyanide
Ammon., Chloride	Iron, Sulphide	— Ferrocyanide
Ammon., Oxalate	Lead, Acetate	— Hydrate
Antimony, Sulphide	Lead, Carbonate	— Iodide
Barium, Chloride	Litharge	— Nitrate
Boric Acid	Litmus	— Sulphate
Bleaching Powder	Magnesium, Carbonate	Silver Nitrate
Calcium, Chloride	Magnesium, Sulphate	Sodium, Borate
Calcium, Chloride	Manganese, Peroxide	— Carbonate
Calcium, Nitrate	Microcosmic Salt	— Phosphate
Copper, Nitrate	Oxalic Acid	Strontium, Nitrate
Copper, Sulphate	Phosphorus	Sulphur
Quartz	Potassium, Bichromate	Tartaric Acid
Selenia	— Binocalate	Tin, Granulated
Salts, Tincture	— Cyanide	Tin, Protochloride
Sulphur Pyrites	— Carbonate	Zinc, Granulated
	— Chlorate	



4783.

83. PORTABLE CHEMICAL CABINET, IN MAHOGANY, represented by Fig. 4783, *price 52s. 6d.* CONTENTS.

17. Retort Stand, 3 rings	1610. Filter Ring, 2 arms
12. Porcelain Mortar, 00	2410. Clark's Test Glass
11. Glass Spirit Lamp, 1 oz.	2426. Box of Six Test Paper Books
14. Cotton Wick, 1 yard	1800. Porcelain Test Plates, No. 8, 9 (2)
11. Blowpipe	115. Stirrers, 2 each, 3 and 6 inches
10. Platinum Blowpipe Wire	4360. Open Tubes, $\frac{1}{8}$ and $\frac{1}{4}$ inch (2)
17. Platinum Blowpipe Foil	2437. Test Metals, Cu, Fe, Zn
18. Albata Test Spoon	387. Test Tube Holder
12. Iron Spoon for Fusions	1690. Straight Pipette, 6 inch
15. Iron Tongs with Spoon	1581. Test Tube Brush
12. Set of 3 Beaker Glasses	1805. Glass Retort, 2 ounce
11. Set of 3 Beaker Glasses	1405. Glass Receiver, 2 ounce.
10. Glass Flasks, 1, 2, and 3 ounces	1785. Watch Glasses, 2 inch (2)
19. Bulb Tube, large size (2)	1790. Capsule with Handle (2)
13. Gas Bottle Funnel and Tube, small	1743. Porcelain Basin, No. 00
21. Cork and Jet for ditto	1743. Ditto. No. 1
10. Test Tubes, 3 by $\frac{3}{4}$ inch (2)	1800. Porcelain Cup, No. 12 (2)
„ 4 by $\frac{3}{4}$ inch (3)	1800. Ditto. No. 10
„ 6 by 1 inch (1)	1800. Ditto. No. 1
„ 3 by $\frac{1}{2}$ inch (6)	1800. Ditto. No. 2
16. Folding Frame for Six Tubes]	1323. Porcelain Crucible, No. 000
16. Glass Funnel, No. 1, $1\frac{1}{4}$ inch	1323. Ditto. No. 00
16. Glass Funnel, No. 2, $1\frac{1}{2}$ inch	2071a. Beehive Shelf, 4 inch
16. Filters for No. 1 Funnel (100)	477. Graduated Measure, 1 oz.
16. Filters for No. 2 Funnel (100)	

Continued on page 406.

4783. PORTABLE CHEMICAL CABINET, *price 52s. 6d., continued—*

SIXTY CHEMICAL PREPARATIONS, contained in 9 stoppered 2 ounce glass bottles, 6 stoppered $\frac{1}{4}$ ounce glass bottles, 18 half-ounce wooden boxes, and 27 quarter-ounce paper boxes:—

Alum	Iron, Sulphate	Potassium, Cyanide
Ammon., Caustic	Iron, Sulphide	— Ferridcyanide
— Carbonate	Lead, Acetate	— Ferridcyanide, <i>sol.</i>
— Chloride	— Acetate, <i>solution</i>	— Ferrocyanide
— Oxalate	— Carbonate	— Hydrate
Antimony, Sulphide	— Nitrate, <i>solution</i>	— Iodide
Arsenious Acid	Litharge	— Nitrate
Barium, Chloride	Litmus	— Sulphate
— Chloride, <i>solution</i>	Magnesium, Carbonate	Realgar
— Nitrate	— Sulphate	Silver, Nitrate, <i>solution</i>
Boracic Acid	Manganese, Peroxide	Sodium, Borate
Benzoic Acid	Mercurous, Chloride	— Carbonate
Calcium, Chloride, <i>solution</i>	Microcosmic Salt	— Phosphate
Cobalt, Nitrate, <i>solution</i>	Oxalic Acid	Strontium, Chloride
Cobalt Ore	Phosphorus	— Nitrate
Copper, Sulphate	Platinum, Bichloride, <i>solution</i>	Sulphur
Copper Turnings	Potassium, Bichromate	Tartaric Acid
Fluorspar	— Binoxalate	Tin, Chloride
Galena	— Bitartrate	Tin, Granulated
Iron Pyrites	— Chlorate	Zinc, Granulated

4784. PORTABLE CHEMICAL CABINET, in a divided DEAL Box, *stained Red*, with lock and key. Price 42s.

The articles in this Cabinet are intended for the use of an Amateur who wishes to repeat Class Experiments, and also to commence QUALITATIVE ANALYSIS. It contains thirty chemicals in the solid state, and the principal instruments used in testing operations, and these are of larger sizes than the instruments contained in the cabinets described above. But the collection contains no Test Solutions, and the Experimenter must provide himself with a few stoppered bottles, and prepare solutions when he requires them. See also sets of Reagents, No. 4810.

CONTENTS.

62. Porcelain Mortar, 2 $\frac{1}{2}$ inches	359. Test Tube Frame, 6 holes
7. Retort Stand, 3 rings	158. Test Tube Brush
851. Spirit Lamp	387. Holder for hot Test Tubes
864. Cotton Wick, in a box	2410. Clark's Test Glass
1191. Stoneware Lamp Cylinder	98. Albata Test Spoon
1194. Ring tops for ditto, a pair	2424. Book of Blue Litmus
1195. Hot Plates for ditto, a pair	2424. Book of Red Litmus
1196. Trellis top for ditto	2437. Test Metals, Fe, Cu, Zn
1197. Tinplate Sand Bath, 5-inch	115. Stirrers, 6-inch, 2
1201. Support for 7 Tubes, on stand	1626. Funnel, 2-inch
4201. Blowpipe	1626. Cut Filters, 100, 3 $\frac{3}{4}$ -inch
4321. Charcoal Pastilles, (36)	1610. Filter Ring, 2 sizes
4320. Porcelain Crucible for ditto	1690. Straight Pipette, 6-inch
4321. Wire Pastille-holders (2)	1766. Porcelain Basin, 3 $\frac{1}{2}$ -inch
92. Iron Spoon	1790. Capsule, with handle
93. Spring Tongs, to hold spoon	1800. Flat Capsule, No. 10
1800. Porcelain Cups, 1, 2, 3	1760. Semiporcelain Basin, 4 $\frac{1}{2}$ inch
4376. Arsenic Tubes, <i>six</i>	1785. Watch Glasses, 2-inch, 2
1400. Flasks, 2, 4, 6 ounces	1994. Gas Bottle
1442. Set of 3 Beaker Glasses	2072. Beehive Shelf, 2 inch
1815. Clark's Retort and Receiver	2124. Gas Tubes, 3 assorted
1429. Bulb Tubes, <i>two</i>	2124. Ditto, large, 6 by 1 inch, 2
2400. Test Tubes, 6 by $\frac{5}{8}$ -inch, 12	477. Graduated Measure, 1-ounce
Ditto, 6 by 1 inch, 3	Open Glass Tubes, $\frac{1}{4}$ lb.

Continued on page 407.

84. PORTABLE CHEMICAL CABINET, *price 42s., continued—*

THIRTY CORKED BOTTLES 1-ounce size, containing the following solid CHEMICALS.

Ammon. Carbonate	Lead Acetate	Potass. Ferrocyanide
— Chloride	Litmus	— Nitrate
Mercur. Chloride	Magnesia Sulphate	Sodium Borate
Mercur. Chloride	Manganese Peroxide	— Carbonate
Copper Sulphate	Microcosmic Salt	— Sulphate
— Sulfide	Oxalic Acid	— Phosphate
— Sulphate	Potass. Bichromate	Strontium Chloride
	— Bisulphate	Sulphur
	— Chlorate	Turmeric
	— Hydrate	Zinc Cuttings

85. STOCKHARDT'S SCHOOL of CHEMISTRY; a Collection of Apparatus suitable for the performance of the principal Experiments described in that work. Packed in a case. Price 16s.

CONTENTS.

05. Retort, 4-ounce size	2400. 6 Test Tubes, each 5 by $\frac{1}{2}$ in. & 6 by $\frac{5}{8}$ in.
05. Receiver, 4-ounce size	359. Test Tube Frame, for 6 Tubes
04. Flasks, 3, 4, 6, 8 oz.	2414. Test Glass, 4 oz., conical
02. Set of 3 Beaker Glasses	1626. Funnels $1\frac{1}{2}$ and 2 inch
02. Spirit Lamp, stoneware	1626. Filters, 100 of each, 2 sizes
01. Blowpipe.	1616. Slips of Glass (6)
09. Platinum Blowpipe Wire	2433. Book of Blue Litmus
07. Platinum Blowpipe Foil	Bar of Pure Zinc
02. Porcelain Mortar, No. 00	115. Glass Stirrers, 2 each, 3 and 6 inch
04. Lamp Wick, 3 feet	1766. Semiporcelain Basin, $3\frac{1}{2}$ inch
01. Lamp Cylinder, 6-inch	2014. Oxygen Retort and Tube
06. Trellis Top for it	1963. Hydrogen Gas Bottle
03. Tube and Support, on stand	2071. Beehive Shelf, 4-inch
02. Iron Spoon	231. Glass Tubes, $\frac{1}{4}$ lb. mixed
03. Porcelain Crucible, No. 0	177. Round File, in handle

GROUP II.—*Collections of Apparatus for the use of Students in Classes where Practical Chemistry is taught, Nos. 4786 to 4792.*

86. ROYAL COLLEGE of CHEMISTRY, LONDON. APPARATUS required by Students commencing the Study of QUALITATIVE ANALYSIS at the above INSTITUTION. *Price of the set, in a deal box, planed smooth, with sliding cover.* 50s.

CONTENTS.

0. Test Tubes, 24, 6 by $\frac{5}{8}$ inch	229. Triangular File, in handle
Boiling Tubes, 2, 8 by $1\frac{1}{4}$ inch	171. Set of 4 Cork Borers
5. Test Tube Frame, 24 holes	168. Corks, 3 dozen, assorted
6. Glass Funnels, 3 of $2\frac{1}{2}$ inch	121. Brass Crucible Tongs, No. 3
„ 1 of $1\frac{1}{2}$ inch	92. Iron Spoons, 2
„ 1 of 3 inch	4204. Brass Blowpipe
3. Cut Filters, 100 of $2\frac{3}{4}$ inch	4279. Platinum Foil, 2 by 1 inch
„ 100 of $3\frac{3}{4}$ inch	4270. Platinum Wire, 3 inches
„ 100 of $5\frac{1}{2}$ inch	158. Test Tube Brushes, 1 and 2
3. Porcelain Basin, $3\frac{1}{4}$ inch	2491. Chloride of Gold, in $\frac{1}{2}$ oz. bottle
„ 3 $\frac{1}{2}$ inch	2527. Chloride of Platinum, 5 $\frac{1}{2}$, in $\frac{1}{2}$ oz. bottle
„ 4 $\frac{1}{2}$ inch	2550. Silver Nitrate, in $\frac{1}{2}$ oz. bottle
0. Glass Flasks, 2 of 8 oz.	2476. Cobalt Nitrate, in $\frac{1}{2}$ oz. bottle
0. Ditto, 3 of 16 oz. oval	Methylated Spirit, pint in a bottle
6. Glass Stirrers, 3 of 6 inch	2426. Box of Test Papers
0. Glass Tubes, $\frac{1}{4}$ lb.	Basket for Draining Test Tubes
0. Washing Bottle, pint, 2 tubes	1953. Vulcan. Tube, $\frac{3}{8}$ in. 24 inches
0. Bunsen's Gas-burner	1953. „ „ $\frac{1}{16}$ in. 12 inches
0. Set of 5 Beakers	288. Retort Stand, 3 brass rings
0. Mortar and Pestle, 4 inch	1191. Lamp Cylinder, 6 inch
7. Watch Glasses, 6	Box
0. Round File, in handle	

4787. GUYS HOSPITAL, LONDON. PROFESSOR A. S. TAYLOR'S PRACTICAL CLASSES in CHEMISTRY. Set of Apparatus required by each student. In smooth deal box, with sliding top. Price 25s.

CONTENTS.

851.	Glass Spirit Lamp	1723.	Washing Bottle, pint, 2 tubes
864.	Cotton Wick, in a box	1616.	Slips of Glass, 4 by $\frac{1}{2}$ inch (4)
291.	Retort Stand	4360.	Open Glass Tubes, 12 by $\frac{3}{8}$ inch (12)
306.	Triangle, with clay ribs	1982.	Gas Bottle for SH, with tube
1197.	Tin Sand Bath, 5 inch	1785.	Watch Glasses (3)
1200.	Stoneware Water Bath	115.	Glass Stirrers, 6 inch (2)
4201.	Blowpipe	2400.	Test Tubes, 6 by $\frac{3}{4}$ inch (12)
4277.	Blowpipe Foil, 2 by $\frac{3}{4}$ inch		Test Tubes, 4 by $\frac{1}{2}$ inch (12)
4270.	Blowpipe Wire, 6 inch	371.	Test Tube Frame, 8 pegs
1323.	Porcelain Crucible, 1 inch	158.	Test Tube Brush, No. 1
1323.	Porcelain Crucible, $1\frac{1}{2}$ inch	2426.	Box of Test Papers
1212.	Bright Iron Crucible Tongs	1953.	Vulc. Tube, $\frac{1}{4}$ inch, 1 foot
99.	Spatula, 4 inch, in handle	1626.	Glass Funnel, $1\frac{1}{2}$ inch
62.	Porcelain Mortar, $2\frac{1}{2}$ inch		Ditto $2\frac{1}{2}$ inch
1462.	Set of 3 Beaker Glasses		Cut Filters, $2\frac{3}{4}$ inch (100)
1743.	Porcelain Basin, $3\frac{1}{2}$ inch		Ditto $4\frac{1}{2}$ inch (100)
	Ditto $3\frac{3}{4}$ inch	229.	File, triangular, in handle
1400.	German Flasks, 4 oz. (2)	177.	File, round, in handle
1409.	Flask, 12 oz., round bottom		

4788. COLLECTION OF APPARATUS and TESTS for the QUALITATIVE ANALYSIS OF SALTS that DISSOLVE in WATER, according to the process for School Teaching, described in GRIFFIN'S "*Chemical Recreations*," part I., page 65.

4789. SET A. FOR INDICATING TESTS. Every pupil requires this set. Price 16s.

62.	Porcelain Mortar, No. 00	1626.	Glass Funnel, $1\frac{1}{2}$ inch
91.	Albata Test Spoon	342.	Support for Funnel
1400.	Flask, 2 ounce	1690.	Pipettes, 5 inch, two
2769.	Pipette, 25 septems	2410.	Test Glasses, conical, 8
851.	Glass Spirit Lamp	115.	Stirrers, 3 inch, 8
864.	Cotton Wick for lamp	2400.	Boiling Tubes, 6 by 1 inch, 2
132.	Brass Tongs to trim lamp	386.	Handle for Hot Tubes
1191.	Furnace Cylinder	2423.	Book of Red Litmus
1196.	Trellis Top for Furnace	2423.	Book of Blue Litmus
1626.	Box, with 100 Filters, $2\frac{3}{4}$ inch	4474.	Tubes for SH Gas
1610.	Filter Ring	1556.	Pipette Bottles, 1 oz. size, nine
254.	Water Bottle	1576.	Bottles with stoppers, 1 oz., two

4790. SET B. FOR CONFIRMING TESTS. Each set suffices for four or five pupils. Price 23s.

1800.	Porcelain Cup, 1 inch	2400.	Closed Tubes, 2 by $\frac{1}{2}$ inch, 3
291.	Retort Stand	2426.	Box of Test Papers
4201.	Blowpipe	4349.	Support for Sublimates
4230.	Blowpipe Lamp and Stand		Borax, in a box
4270.	Platinum Wires, two		Microcosmic Salt, in a box
4277.	Platinum Foils, two		Soda, Carbonate, in a box
4282.	Platinum Tongs	2426.	Cobalt Nitrate, 2 oz. bottle
4296.	Thin Copper Wire		Stoppered Bottles, to contain
4321.	Charcoal Pastilles, 36		Solutions, 2 oz. size, labelled,
4320.	Crucible for ditto, two		empty, 8
4321a.	Wire Supports for ditto, two		Corked Bottles, with wide mouths,
4395.	Hammer		contain Dry Tests, 1 oz. size, labelled
4397.	Anvil		but empty, 7

91. SET C. PROVISION OF TESTS to be made by the TEACHER, from which to supply the Bottles of Sets A and B, when preparing for the LESSON. The solutions may be of the strengths described at page 274 in this work. The price is for SIX OUNCE BOTTLES, full of the Liquid Re-agents in the following List (excepting the Gold and Platinum solutions), and for TWO OUNCE BOTTLES of Dry Re-agents. Price, including bottles, 32s.

INDICATING TESTS.	CONFIRMING TESTS.	TESTS IN DRY STATE.
8. Sodium Carbonate	2532. Potassium Chromate	Calcium Sulphide
10. Ammonia	2531. ——— Bichromate	2655. Potass. Bisulphate
16. Potassium Hydrate	2535. ——— Ferrocyanide	2613. Ferrous Sulphate
14. ——— Ferridcyanide	——— Antimoniate	2641. Manganese Peroxide
14. Barium Nitrate	2473. Calcium Sulphate	2632. Stannous Chloride
10. Silver Nitrate	2452. Ammon. Molybdate	Copper Sulphate
10. Calcium Chloride	2572. Sulphuric Acid Concent.	Lead Acetate
12. Nitric Acid	2496. Hydrochloric Acid	Magnesium Sulphate
1. Lead Nitrate	2527. Platinum Chloride, 5°.	2627. Sodium Chloride
	$\frac{1}{2}$ oz.	
	2491. Gold Chloride, $\frac{1}{2}$ oz.	

92. THE COMPLETE SET, A, B, C, Nos. 4789, 4790, 4791, price £3 11s.

This collection can be enlarged by additions from the List given at No. 4826, page 414.

GROUP III.—*Collections of Apparatus used by Candidates for Certificates when undergoing their Examinations in Practical Chemistry, Nos. 4793 to 4798.*

93. OXFORD LOCAL EXAMINATION. CANDIDATES in CHEMISTRY must provide themselves with the following APPARATUS for the PRACTICAL EXAMINATION. *Price of the Set, in a packing-case, 14s. 6d.*

94. This Apparatus can also be supplied in a smooth box, having a lid with hinges and a padlock, price 17s.

CONTENTS.

Glass Funnels, 2-inch	Retort Stand, Ring, & Triangle	Platinum Wire, 3 inch
Cut Filters for ditto	Spirit Lamp, 3 oz., and wick	3 Sticks of Charcoal
Test Tubes, 6 by $\frac{3}{4}$ inch	Bottle with 5 oz. spirit	3 Closed Tubes, 4 by $\frac{1}{2}$ inch
Frame for 24 Test Tubes	Washing Bottle pint, 2 tubes	Penknife
Glass Stirrers, 9-inch	Blowpipe	Cloth
Porcelain Basins, 2 $\frac{3}{4}$ inch	Platinum Foil, 2 $\frac{1}{2}$ by 1 inch	Test Tube Brush

95. CAMBRIDGE LOCAL EXAMINATION. CANDIDATES in PRACTICAL CHEMISTRY must provide themselves with the following APPARATUS for the EXAMINATION. *Price of the Set, in a packing-case, 12s.*

96. The same Apparatus in a smooth box, having a lid with hinges and a padlock, price 14s. 6d.

CONTENTS.

Funnels, 2 inch	Washing Bottle, pint, 2 tubes	Blowpipe
Cut Filters to fit ditto	3 Test Tubes, 4 by $\frac{1}{4}$ inch	Platinum Blowpipe Wire, 3 in.
Test Tubes, 6 by $\frac{3}{8}$ inch	Spirit Lamp, 3 oz., and wick	Platinum Blowpipe Foil, 2 by $\frac{3}{4}$ in.
Test Tube Frame, 24 holes	5 oz. Spirit in a bottle	Penknife
Glass Stirrers, 9 inch	Lamp Cylinder, 6-inch	3 Sticks of Charcoal
Porcelain Basin, 3 $\frac{1}{2}$ inch	Iron Top for Cylinder	

REAGENTS to accompany this APPARATUS. *See page 410.*

4796a. RE-AGENTS to be provided by each CANDIDATE in PRACTICAL CHEMISTRY for the CAMBRIDGE LOCAL EXAMINATION.

The Liquids are of the strength described at page 274. In two-ounce white glass stoppered bottles. *Price of the set, in a smooth deal box with sliding cover, 16s.*

	s.	d.		s.	d.
2449. Ammonium, Carbonate	-	7	2550. Silver; Nitrate	1	
2450. ————— Caustic		6	2561. Sodium, Phosphate	-	
2451. ————— Chloride		6	2571. Sulphuric Acid	-	
2453. ————— Oxalate	-	8	Tartaric Acid	-	
2454. ————— Sulphide	-	10	DRY TESTS:—		
2462. Barium, Chloride	-	6	2650. Borax	-	1
2471. Calcium, Hydrate	-	6	2652. Sodium, Carbonate	-	1
2496. Hydrochloric Acid	-	7	2640. Iron Sulphide	-	
2514. Magnesium, Sulphate	-	6	Bottle for Sulph. Hydrogen Gas...	1	
2522. Nitric Acid	-	8	Box containing Rods of Copper		
2536. Potassium Hydrate	-	9	and Zinc, books of Litmus and		
2535. ————— Ferrocyanide	-	7	Starch Paper	1	

4797. DEPARTMENT OF SCIENCE AND ART, KENSINGTON. APPARATUS and REAGENTS with which CANDIDATES make their Analyses in LOCAL EXAMINATIONS in PRACTICAL CHEMISTRY. In a smooth deal box, containing a Division for the Bottles, and having a lid with hinges and a padlock price 2l. 12s. 6d.

CONTENTS.

2400. Test Tubes, 6 by $\frac{5}{8}$ inch, 12	1743. Porcelain Basin, 3 $\frac{1}{2}$ inch
371. Test Tube Stand, 8 holes and pegs	1785. Watch Glasses, 2-inch, six
287. Retort Stand, 3 brass rings	1323. Porcelain Crucible and Cover, 1 $\frac{1}{2}$ -inch
1724. Washing Bottle, pint size, 2 tubes	1323. Ditto Ditto 2 $\frac{1}{4}$ -inch
851. Glass Spirit Lamp	306. Triangle to support Crucibles
864. Cotton Wick in a box	158. Test Tube Brush
92. Iron Spoons, two	2424. Blue and Red Litmus Paper
93. Steel Spring Tongs to hold spoon	2470. Platinum Blowpipe Wire, 3 inch
121. Iron Crucible Tongs	2478. Platinum Foil, 2 by 1 inch
62. Porcelain Mortar, 2 $\frac{1}{2}$ inch	1626. Glass Funnel, 2 $\frac{1}{2}$ and 3 inch
4201. Black's Blowpipe	1626. Cut Filters, 100 for each funnel
4299. Charcoal for Blowpipe Experiments	1996. Bottle for HS gas
1743. Porcelain Basin, 2 $\frac{3}{4}$ inch	115. Glass Stirrers, 6 and 9 inch

LIQUID REAGENTS, strength described at page 274, in white glass stoppered bottles Fig. 1550, all 2 ounce except Nos. 2527 and 2550.

Acetic Acid	Calcium Sulphate	Platinic Chloride, $\frac{1}{2}$ oz. 2527
Ammon. Carbonate	Ferric Chloride	Potass. Chromate
„ Chloride	Hydrochloric Acid	„ Ferrocyanide
„ Hydrate	Hydrofluosilicic Acid	„ Hydrate
„ Oxalate	Hydrosulphuric Acid	„ Sulphate
„ Sulphide	Lead Acetate	Silver Nitrate, $\frac{1}{2}$ oz. 2550
Barium Chloride	Magnesia Sulphate	Sulphuric Acid
Calcium Chloride	Nitric Acid	Sodium Phosphate
„ Hydrate	Oxalic Acid	Tartaric Acid crystals

REAGENTS IN THE SOLID STATE, in 2 ounce white glass stoppered bottles, Fig. 1576 page 278.

Calcium Hydrate (pasty)	Potassium Cyanide	Sodium Borate
Ferrous Sulphate	„ Nitrate	„ Carbonate
		Tartaric Acid

4798. The ABOVE COLLECTION of APPARATUS and REAGENTS is sometimes supplied with a 1 inch Platinum Crucible, No. 1320, 3, and a Herapath's Gas Blowpipe, No. 1180. The price, with these additions, is 3l. 18s.

GROUP IV.—*Collections of Chemical Reagents in Solutions, of the Systematic Degrees of Strength described at page 272, Nos. 4809 to 4821.*

509. COLLECTIONS OF CHEMICAL TESTS IN SOLUTION, of the DEGREES OF STRENGTH described in the Section commencing at page 272.

The following assortments are given merely as examples. Collections containing any number and any size of Bottles can be made at pleasure, according to the Tariff given in the Table at page 274. Supplies of LARGER QUANTITIES of these Solutions, such as 80 ounce Winchester, prepared to order.

310. COLLECTION OF FORTY BOTTLES OF REAGENTS. 2 ounce size, namely, 33 narrow-mouthed bottles with Solutions, and 7 wide-mouthed bottles with Solids. Particulars as given in the following list. Price, with common bottles, Fig. 1550, page 273, and Fig. 1576, page 278, 28s. 6d.

311. The same Collection in the best bottles, Fig. 1551, page 273, and Fig. 1577, page 278. Price 44s.

	s.	d.		s.	d.
47. Acetic Acid	1	—	2523. Oxalic Acid	—	7
49. Ammon. Carbonate	—	7	2531. Potassium Bichromate	—	7
50. Ammonia	—	6	2532. — Chromate	—	7
51. Ammon. Chloride	—	6	2534. — Ferridcyanide	—	8
52. Ammon. Molybdate	—	7	2535. — Ferrocyanide	—	7
54. Ammon. Sulphide	—	10	2536. — Hydrate	—	9
62. Barium Chloride	—	6	2537. — Iodide	—	11
64. Barium Nitrate	—	6	2540. — Sulphocyanide	—	8
70. Calcium Chloride	—	6	2550. Silver Nitrate	1	2
71. Calcium Hydrate	—	6	2558. Sodium Carbonate	—	7
73. Calcium Sulphate	—	6	2571. Sulphuric Acid	—	7
77. Copper Sulphate	—	6	2572. — concentrated	—	9
96. Hydrochloric Acid	—	7	DRY TESTS.		
99. Ferric Chloride	—	8	2602. Ammon. Sesquicarbonate	—	10
01. Ferrous Sulphate	—	7	2615. Lime Chloride	—	8
05. Indigo Sulphate	—	6	2616. Litmus	1	1
11. Lead Nitrate	—	6	2631. Tartaric Acid crystals	1	7
16. Mercuric Chloride	—	8	2655. Potassium Bisulphate	1	1
17. Mercurous Nitrate	—	7	2629. Sodium Sulphide	1	8
18. Mercuric Potassium-iodide	—	11	2641. Manganese Peroxide	—	6
22. Nitric Acid	—	8			

12. COLLECTION OF SIXTY BOTTLES OF REAGENTS, of 2 ounce size, comprising 45 bottles with Liquids and 15 bottles with Solids. Particulars below.

12. Price of the 60 bottles of the common form, 2*l.* 10s.

13. Price of the 60 bottles of the best form, 3*l.* 13s. 6d.

	s.	d.		s.	d.
7. Acetic Acid	1	—	2483. Ether Sulphuric	1	3
8. Alcohol	1	1	2496. Hydrochloric Acid	—	7
9. Ammon. Carbonate	—	7	2497. Hydrofluosillicic Acid	—	10
0. Ammonia	—	6	2498. Hydrosulphuric Acid	—	7
1. Ammon. Chloride	—	6	2499. Ferric Chloride	—	8
2. „ Molybdate	—	7	2501. Ferrous Sulphate	—	7
3. „ Oxalate	—	8	2505. Indigo Sulphate	—	6
4. „ Sulphide	—	10	2510. Lead Acetate	—	6
2. Barium Chloride	—	6	2511. Lead Nitrate	—	6
3. „ Hydrate	—	6	2514. Magnesian Sulphate	—	6
4. „ Nitrate	—	6	2516. Mercuric Chloride	—	8
0. Calcium Chloride	—	6	2517. Mercurous Nitrate	—	7
1. „ Hydrate	—	6	2518. Mercuric Potassium-iodide	—	11
3. „ Sulphate	—	6	2522. Nitric Acid	—	8
5. Chlorine Water	—	6	2523. Oxalic Acid	—	7
6. Cobalt Nitrate	1	9	2531. Potassium Bichromate	—	7
7. Copper Sulphate	—	6	2532. — Chromate	—	7

Continued on page 412.

1818. COLLECTION OF NINETY-THREE BOTTLES OF REAGENTS, comprising 61 bottles for Solutions; of which 17 are of 2 ounce, 29 of 6 ounce, and 15 of 10 ounce size; also 32 bottles for Dry Reagents, of which 12 are of 2 ounce, 14 of 6 ounce, and 6 of 10 ounce size. Particulars given below, where the number that follows each name indicates the size of the bottle.
1818. Price of the 93 bottles of the common form, 7*l.* 12*s.*
1819. Price of the 93 bottles of the best form, 10*l.*
1820. COLLECTION OF EIGHTY-SEVEN BOTTLES OF REAGENTS. This is the same Collection as the above, with the omission of 4 bottles containing Alcohol, Ether, Gold Chloride, and Platinic Chloride.
1820. Price of the 87 bottles of the common form, 6*l.* 9*s.*
1821. Price of the 87 bottles of the best form, 8*l.* 14*s.* 6*d.*

	oz.	s.	d.		oz.	s.	d.
2447. Acetic Acid	6...	1	9	2557. Sodium Bitartrate	2...	—	8
2448. Alcohol	10...	4	—	2558. „ Carbonate	10...	1	6
2449. Ammon. Carbonate.....	10...	1	6	2559. „ Chloride	6...	—	9
2450. Ammonia	10...	1	1	2560. „ Hydrate	10...	1	11
2451. Ammon. Chloride	6...	—	9	2561. „ Phosphate	6...	—	9
2452. „ Molybdate	2...	—	7	2562. „ Sulphate	2...	—	6
2453. „ Oxalate.....	6...	1	3	2563. „ Sulphide	6...	1	—
2454. „ Sulphide ..	10...	2	9	2571. Sulphuric Acid	10...	1	6
2461. Barium Acetate	2...	—	9	2572. „ „ concentrated	10...	2	4
2462. „ Chloride	6...	—	9	2576. Stannous Chloride	2...	—	8
2463. „ Hydrate	2...	—	6	2577. Starch	6...	—	9
2464. „ Nitrate	6...	—	9				
2470. Calcium Chloride.....	6...	—	9	DRY REAGENTS.			
2471. „ Hydrate	6...	—	8	2602. Ammon. Sesquicarbonate ...	6...	1	7
2472. „ Nitrate	2...	—	8	2606. Barium Carbonate	2...	1	11
2473. „ Sulphate.....	6...	—	9	2607. „ Hydrate	2...	2	—
2475. Chlorine Water	6...	—	9	2612. Gall Nuts	2...	—	9
2476. Cobalt Nitrate	2...	1	9	2613. Ferrous Sulphate.....	6...	2	1
2477. Copper Sulphate	6...	—	9	2615. Lime Chloride	6...	1	—
2483. Ether Sulphuric	10...	4	9	2616. Litmus	2...	1	1
2491. Gold Trichloride.....	2...	8	5	2617. Oxalic Acid	6...	2	8
2496. Hydrochloric Acid	10...	1	6	2619. Potass. Hydrate	6...	2	5
2497. Hydrofluosilicic Acid	6...	1	9	2520. „ — pure	6...	4	6
2498. Hydrosulphuric Acid	10...	1	6	2621. „ Bichromate	2...	1	8
2499. Ferric Chloride	6...	1	2	2625. Sodium Hydrate	6...	2	5
2500. Ferric Sulphate	2...	—	6	2626. „ — pure.....	6...	4	6
2501. Ferrous Sulphate.....	6...	—	11	2627. „ Chloride	6...	1	9
2505. Indigo Sulphate	2...	2	6	2629. „ Sulphide	6...	3	6
2510. Lead Acetate	6...	—	9	2631. Tartaric Acid	6...	3	3
2511. Lead Nitrate	2...	—	6	2632. Tin Protochloride	2...	1	6
2514. Magnesium Sulphate	6...	—	9	2633. Zinc in rods	2...	2	6
2516. Mercuric Chloride	6...	1	3				
2517. Mercurous Nitrate	6...	1	—	FOR GASES.			
2518. Mercuric Potassium-Iodide	6...	2	—	2640. Iron Sulphide	10...	1	7
2522. Nitric Acid	10...	1	11	2641. Manganese Peroxide ...	10...	1	1
2523. Oxalic Acid	10...	1	6	2642. Potass. Chlorate	10...	2	1
2527. Platinic Chloride	2...	6	5	2643. Zinc Granulated	10...	1	4
2529. Potassium Bicarbonate	6...	1	—	2644. Marble	10...	2	—
2530. „ Carbonate	10...	2	4	2645. Fluorspar	10...	1	5
2531. „ Bichromate	6...	1	—				
2532. „ Chromate	6...	1	—	BLOWPIPE TESTS.			
2533. „ Cyanide	2...	—	11	2650. Borax.....	6...	1	8
2534. „ Ferridcyanide ...	6...	1	3	2651. Microcosmic Salt.....	2...	1	6
2535. „ Ferrocyanide	6...	1	—	2652. Sodium Carbonate	6...	1	6
2536. „ Hydrate	10...	2	4	2653. Potassium Cyanide	2...	1	10
2537. „ Iodide	6...	2	—	2655. „ Bisulphate	6...	2	—
2539. „ Sulphate	2...	—	6	2656. „ Nitrate	2...	1	—
2540. „ Sulphocyanide ..	2...	—	8	2658. Boracic Acid, fused	2...	1	9
2550. Silver Nitrate	6...	2	9	2659. Gypsum crystals	2...	1	9
2555. Sodium Acetate	2...	—	6				

GROUP V.—*Collections of Instruments for performing Qualitative Chemical Analysis,*
Nos. 4826 to 4834.

4826. INSTRUMENTS required for QUALITATIVE CHEMICAL ANALYSIS.

This list is made tolerably complete, in order that those who require sets of apparatus for special purposes, may see the whole before them, and be enabled easily to select such instruments as may seem suited for their projected researches. Blowpipe apparatus is left out, it being supposed that one of the sets described at page 379, may be adopted. Arsenic apparatus is omitted, having been fully described at page 395.

4826. Price of the following Collection of Apparatus, £6 8s.

4827. Price of the Blowpipe Apparatus, No. 4523, £3 13s. 6d.

4828. The Combined Collection, £10.

4829. Price of the following Collection, without the Platinum Crucible, Capsule and Spatula, £4 10s.

For REAGENTS to accompany this APPARATUS, consult pp. 411—413.

Where coal gas is available for fuel, the Spirit Lamps may be exchanged for the Rose gas burners Nos. 1 and 2, as described at pages 92, 93, which will cause a small variation in the price of the collection.

	s.	d.		s.	d.
62. Porcelain Mortar, 4 inch	1	—	343. Funnel Holder, 2 arms.....	2	—
860. Spirit Lamp, with rack	2	6	1610. Filter Ring, 2 arms	—	—
861. Plaited Cotton Wick.....	—	6	1611. ditto, 3 arms	—	1
132. Tongs for Lamp	—	2	1677. Round Glass Cover, 3½ in., 3	—	—
870. Argand Spirit Lamp	16	6	4460. Griffin's Quick Filter	—	—
880. Wicks for ditto, 12	—	6	115. Glass Stirrers, 3 inch, 12	—	—
288. Retort Stand, 3 rings	2	6	115. ditto, 6 and 9 inch, 6 each	—	—
1191. Lamp Furnace Cylinder	—	8	1743. Porcelain Basin, 2¾ inch	—	—
1194. Two Iron Ring tops	—	4	1743. ditto, 3½ „	—	—
1195. Two Hot Plates.....	—	2	1743. ditto, 4 „	—	1
1196. Iron Trellis top	—	2	1743. ditto, 6 „	1	—
1197. Sand Bath, 5 inch.....	—	4	1785. Watch Glass, 2 inch, 6.....	—	—
1200. Water Bath	—	8	1786. ditto, 2½ „, 2.....	—	—
1201. Support for 7 tubes	—	6	1790. Capsule and handle, 2.....	—	—
1323. Porcelain Crucible, 1¾ inch.....	—	8	403. Holder for hot Watch Glasses ..	—	—
1323. ditto. 2¼ inch.....	—	10	2410. Conical Test Glass, 2 inch, 6	1	—
1333. ditto. Plattner's (2) ..	1	—	2411. ditto, 1 „, 6	—	—
1320. Platinum Crucible, No. 3.....	18	—	4468. Decanting Tubes, 3	—	—
1321. Platinum Capsule	6	—	1690. Plain Pipettes, 3	—	1
96. Platinum Spatula	14	—	1691. Bulb Pipettes, 3.....	1	—
121. Crucible Tongs	1	6	2400. Test Tubes, 6 by ½ inch, 12.....	1	—
1800. Porcelain Cups, 12	2	6	2400. ditto, 6 by 1 „, 4	—	—
1400. German Flasks, 1, 2, and 3 oz. ...	—	6	2400. ditto, 8 by 1¼ „, 3	—	—
1400. ditto. 4, 6, and 8 oz. ...	—	9	380. Test Tube Frame, 24 holes	5	—
1445. Set of 6 Beakers.....	2	3	4459. Spring holder for hot tubes	—	1
1482. Set of 6 Griffin's Beakers	4	—	1719. Washing Bottle, 1 jet	1	—
1806. Plain Retorts, 4 oz. 2	—	6	1725. ditto, 2 tubes	1	—
1809. Stoppered Retorts, 4 oz. 2	1	4	4472. ditto, Schuster's	1	—
1847. Stoppered Receiver, 4 oz.	—	8	158. Tube Brush, 2 sizes	—	—
1405. Plain Receiver, 4 oz. 2.....	—	5	1616. Slips of Glass 4, 6 inch, 6 each ...	—	—
1815. Clark's Retort and Receiver, 2 ...	2	—	2426. Box of Test Papers	1	—
315. Clamp to support Retorts	3	—	2436. Box of Test Metals	1	—
Wood Block support for Receivers ..	—	9	1996. Bottle for HS gas	2	—
1415. Curved Flask for solutions	1	6	2439. Porcelain Testing Slab.....	1	—
1626. Glass Funnels, 2, 2½, and 3 inch ..	—	8	4509. Square Plate of Blue Glass	1	—
1626. Cut Filters, 100 for each	1	8	4510. Glass Prism with Indigo solution ..	3	—
1626. Box to hold Filters	—	9	232. Open glass tubes, 18 inch, ¼ lb. ...	—	—

330. ELEMENTARY SET OF INSTRUMENTS for QUALITATIVE CHEMICAL ANALYSIS.

Price of the Collection, 40s.

This set requires the addition of Blowpipe Apparatus, such as the set No. 4521, price 10s. 6d.; or, set No. 4522, price 21s. Also, a set of Liquid Tests, such as No. 4810, price 28s. 6d.; No. 4816, price 36s.; or, No. 4812, price 50s.

	s.	d.		s.	d.
62. Porcelain Mortar, 2½ inch	—	7	1610. Filter Ring, 2 arms	—	5
51. Glass Spirit Lamp, 3 oz.	1	—	4460. Griffin's Quick Filter	—	3
64. Cotton Wick for Lamp.....	—	2	115. Glass Stirrers, 3 inch, 12.....	—	2
32. Tongs to trim Lamp	—	2	115. ditto, 6 and 9 inch, 6 each	—	6
88. Retort Stand, 3 rings	2	6	1768. Porcelain Basins, set of 6	1	8
91. Lamp Furnace Cylinder	—	8	1785. Watch Glasses, 2 inch, 2.....	—	2
94. Ring tops, a pair	—	4	403. Holder for hot Watch Glasses.....	—	6
95. Hot plates, a pair	—	2	1790. Capsule and handle	—	6
96. Iron Trellis top	—	2	2411. Conical Test Glass, 6	—	9
97. Sand Bath, 5 inch	—	4	4468. Decanting Tubes, 3	—	6
00. Water Bath	—	8	1690. Plain Pipettes, 2	—	4
01. Support for Tubes on sand	—	6	1691. Bulb Pipette	—	4
23. Porcelain Crucible, 1¾ inch	—	8	2400. Test Tubes, 6 by ½ inch, 12.....	1	1
33. ditto Plattner's	—	6	2400. ditto 6 by 1 inch, 2	—	3
21. Crucible Tongs	1	2	360. Test Tube Frame, 12 holes	1	4
00. Porcelain Cups, six	1	3	386. Holder for hot Test Tubes	—	6
00. Glass Flasks 2, 4, and 6 oz.....	—	8	158. Test Tube Brush	—	3
64. Set of 5 Beakers.....	2	—	4472. Washing Bottle	1	—
06. Plain Retort, 4 oz.	—	3	1725. ditto two tubes	1	6
09. Stoppered Retort, 4 oz.	—	8	1616. Slips of Glass, 4 and 6 inch, 6 each	—	4
05. Plain Receiver, 4 oz.....	—	3	2426. Box of Test Papers	1	—
15. Clark's Retort and Receiver	1	—	2436. Box of Test Metals	1	—
26. Glass Funnel, 2, 2½, and 3 inch ...	—	8	1994. Bottle for HS Gas.....	1	—
26. Cut Filters, 100 for each funnel ...	1	8	4509. Plate of Blue Glass	1	—
26. Box to hold the filters	—	9	4510. Indigo Prism	3	—
42. Funnel Holder	1	—	2440. Porcelain Testing Slab	1	—
Open Glass Tubes, six assorted ...	—	4			

31.	{	Price of the above collection of Apparatus	£2	0	0
		„ the Blowpipe Apparatus, No. 4522	1	1	0
		„ the Forty bottles of Reagents, No. 4810	1	8	6
		„ the Combined Collection	4	9	6

32. Price of a similar collection, but with the set of Sixty bottles of Reagents, No. 4812, £5 11s.

33. CABINET of APPARATUS and REAGENTS for QUALITATIVE CHEMICAL ANALYSIS: comprehending the collection of Apparatus, No. 4830; the forty bottles of Pure Tests, No. 4810; and the Blowpipe Apparatus, No. 4522. The whole in a divided Mahogany Cabinet, Price £7 7s.

34. SIMILAR CABINET to No. 4833, but with the 40 bottles No. 4816, instead of No. 4810, the rest as above, price £7 17s. 6d.

35. MAHOGANY CABINETS, containing any other combination of Instruments with sets of Reagents, PREPARED TO ORDER. Generally speaking, the cost of a divided Mahogany Cabinet to contain a collection of Analytical Apparatus and Tests is *about half the cost* of the Apparatus and Tests.

GROUP VI.—*Collections of Analytical Apparatus arranged for special purposes*
Nos. 4839 to 4846.

4839. TOXICOLOGICAL CABINET; containing the most important CHEMICAL INSTRUMENTS and TESTS required in TESTING for POISONS. In a divided mahogany cabinet, measuring 19 inches in length, 15 inches in width, and 10 inches in depth. Price £4 14s. 6d.
4840. The APPARATUS AND TESTS, complete, but without the mahogany cabinet. Price £3 3s.

CONTENTS :—

62. Porcelain Mortar, No. 00
851. Glass Spirit Lamp, 3 oz.
863. Cotton Wick for Lamp
239. Retort Stand, 1 ring
4201. Blowpipe
4321. Charcoal Blowpipe Pastilles, 24
4320. Porcelain Crucibles, for ditto, 2
4321a. Wire Handles for ditto, 2
4376. Box of 15 Arsenic Tubes
4409. Albata Test Spoon
1464. Set of 5 Beaker glasses
1442. Set of 3 Beaker glasses
1400. German Flask, 3 ounce
2400. Test Tubes, 4 by $\frac{1}{2}$ inch, 12
2400. Test Tubes, 4 by 1 inch, 3
359. Test Tube Frame, 6 holes
387. Holder for hot Test Tubes
1785. Watch Glasses, 4
403. Holder for Watch Glasses
1419. Bulb Flask, No. 11
2410. Clark's Conical Test Glass
4700. Marsh's Arsenic Apparatus
1994. Sulphuretted Hydrogen bottle

1815. Clark's Retort and Receiver
2426. Box of Test Papers
115. Glass Stirrers, 3 and 6 inch
1600. Glass Pipette, 6 inch straight
1626. Glass Funnel, $1\frac{1}{2}$ inch
— Cut Filters for ditto, 100
— Glass Funnel, $2\frac{1}{2}$ inch
— Cut Filters for ditto, 100
1610a. Porcelain Filter Ring, 2 arms
1323. Porcelain Crucible, $1\frac{1}{2}$ inch
— ditto, $1\frac{3}{4}$ inch
1743. Porcelain Basin, $2\frac{3}{4}$ inch
— ditto, $3\frac{1}{2}$ inch
1800. Porcelain Cups, 8 assorted
477. Graduated Measure, 1 ounce
236. Glass Tubes, open, $\frac{1}{4}$ lb.

STOPPERED GLASS BOTTLES FOR TESTS :—

6 Narrow mouthed for Liquids, 4 ounce

7 ditto ditto 2 „

8 ditto ditto 1 „

14 Wide mouthed for Solids, 1 „

Containing the following CHEMICALS :—

Ammon. Carbonate
— Oxalate
— Sulphide
Barium Chloride
— Nitrate
Charcoal powder
Copper, pure foil
— Sulphate
Ferric Chloride
Ferrous Sulphide
Ferrous Sulphate

Galls, Tincture
Gold Chloride
Flux, Black
Indigo Sulphate
Lead Acetate
Mercuric Chloride
Platinic Chloride
Potassium Bichromate
— Carbonate
— Cyanide
— Ferridcyanide

Potassium Ferrocyanide
— Hydrate
— Iodide
— Nitrate
Silver Nitrate
Sodium Carbonate
— Phosphate
Tartaric Acid
Tin Chloride
Zinc, free from Arsenic

LABELLED BOTTLES to contain Acids and Alkalies. MAHOGANY CABINET.

4841. HOSPITAL LABORATORY, CHEMICAL CABINET for MEDICAL MEN, containing a careful selection of CHEMICAL APPARATUS and PURE TESTS suitable for such chemical processes of TESTING, as commonly have to be performed by PHYSICIANS in HOSPITALS, or in private practice; such as testing for poisons, examination of blood or urine, testing for adulterations, investigation of the purity of medicines, &c. The instruments of the best quality, but of small size, arranged in a divided mahogany cabinet with drawers and trays, so as to be always convenient for use. Size of the cabinet, $24\frac{1}{2}$ inches in length, 18 inches in width, and $12\frac{1}{2}$ inches in depth. Price £10 10s.
4842. The APPARATUS AND TESTS, without the Platinum crucible, and the mahogany Cabinet. Price £6 6s. [Contents on page 417]

841. HOSPITAL LABORATORY, *continued*—

CONTENTS.

62. Porcelain Mortar, No. 0
 99. Steel Spatula with handle, 4 inch
 437. Balance with grain weights
 477. Graduated Measure, 1 ounce
 851. Glass Spirit Lamp, 4 oz.
 864. Cotton Wick for Lamp
 191. Stoneware Lamp Cylinder
 197. Sand Bath for ditto, 5 inch
 201. Support for Tubes on sand
 196. Trellis top for furnace
 194. Ring top for furnace, 2
 200. Water Bath for furnace
 287. Retort Stand, 3 brass rings
 204. Brass Blowpipe
 232. Blowpipe Lamp
 241. Brass Stand for Lamp
 321. Charcoal blowpipe supports, 72
 320. Porcelain Crucible for ditto, 2
 321a. Wires to hold ditto, 2
 270. Platinum Blowpipe Wires, 3
 277. Platinum Blowpipe Foils, 2
 741. Platinum Capsule, $\frac{1}{4}$ inch
 741. ditto $\frac{3}{4}$ inch
 320. Platinum Crucible, 1 inch, no cover
 741. Fine Copper Wire, 1 yard
 92. Iron Spoons, 2
 283. Spring Steel Tongs for ditto
 282. Platinum Blowpipe Tongs
 135. Iron Tongs with Spoon handle
 132. Brass Tongs to trim Lamp
 438. Albata Test Spoon
 397. Blowpipe Anvil
 395. Blowpipe Hammer
 265. Bulb Tube for Hydrates, 4
 400. Glass Flasks, 3 and 4 ounce
 400. ditto 6 and 8 ounce
 419. Bulb Boiling Tubes
 482. Set of 6 Beaker tumblers
 465. Set of 5 Beaker glasses
 786. Watch Glasses, 3 inch, 2
 784. ditto $2\frac{1}{2}$ inch, 2
 403. Holder for Watch Glasses
 306. Watch Glass Springs, 2
 400. Test Tubes, 5 by $\frac{1}{2}$ inch, 12
 2430. Test Tubes, 3 by $\frac{5}{8}$ inch 6
 — ditto 4 by $\frac{3}{4}$ „ 6
 359. Test Tube Frame, 6 holes
 387. Holder for hot Test Tubes
 2408. Nest of 9 Test Tubes, in case
 1800. Porcelain Cups, 12 assorted
 2410. Clark's Test Glass, Conical, 5
 115. Glass Stirrers, 3 inch, 6
 115. ditto 6 inch, 6
 1690. Glass Pipettes, plain, 6 each
 1691. ditto 1 bulb, 1 bent
 231. Open Glass Tubes, $\frac{1}{4}$ lb.
 1626. Glass Funnels, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ inch
 — Cut Filters for ditto, 100 each
 — Glass Funnel, 3 inch
 1610a. Porcelain Filter Ring, 2 arms
 1611. ditto 3 arms
 1626. Cut Filters, 1 and $1\frac{1}{4}$ inch for ditto
 342. Funnel Holder, Black wood
 1677. Round Glass Covers, 3 inch, 3
 1723. Washing Bottle, $\frac{1}{2}$ pint
 2436. Box of Test Metals
 2427. Box of Litmus Test Papers
 1800. Porcelain White Testing Plates, 2
 1740. Porcelain Evaporating Basins, $2\frac{3}{4}$ inch,
 $3\frac{1}{4}$ inch, $3\frac{1}{2}$ inch, $3\frac{3}{4}$ inch, 4 inch, $4\frac{1}{2}$
inch, $4\frac{3}{4}$ inch, 6 inch, *diameter*
 1323. Porcelain Crucibles with Covers, $1\frac{1}{4}$ inch,
 $1\frac{1}{2}$ inch, $1\frac{3}{4}$ inch, $2\frac{1}{4}$ inch, $2\frac{1}{2}$ inch,
diameter
 4700. Marsh's Arsenic Apparatus
 4376. Box of 15 Arsenic Tubes
 1996. Clark's HS Gas Bottle
 1815. Clark's Retort and Receiver
 1809. Stoppered Retort, 4 ounce
 1968. Small Gas Bottle, 2 necks fitted

STOPPERED GLASS BOTTLES FOR TESTS:—

8	Narrow Mouthed for Liquids, 1 ounce,	
14	ditto	ditto 3 „
3	ditto	ditto 4 „
6	ditto	ditto 7 „
16	Wide Mouthed for Solids, $\frac{1}{2}$	„
7	ditto	ditto 3 „

Containing the following CHEMICALS.

acetic Acid	Ferric Chloride	Potassium Ferridcyanide
ammon. Carbonate	Ferrous Sulphide	— Ferrocyanide
— Chloride	— Sulphate	— Iodide
— Oxalate	Flux, Black	— Nitrate
— Sulphide	Indigo Sulphate	— Sulphocyanide
barium Chloride	Lead Acetate	Silver Nitrate
— Nitrate	Manganese Peroxide	— Ammon. Nitrate
calcium Chloride	Mercuric Chloride	Sodium Carbonate
— Sulphate	Oxalic Acid	— Phosphate
charcoal Powder	Platinic Chloride	Tartaric Acid
cobalt Nitrate	Potassium Bichromate	Tin Chloride
copper, pure foil	— Carbonate	Zinc Chloride
— Ammon. Sulphate	— Cyanide	Zinc free from Arsenic
— Sulphate	— Hydrate	

LABELLED BOTTLES to contain Acids and Alkalies.

4843. CHEMICAL CABINET, containing sufficient APPARATUS and TESTS for the Chemical Examination of AIR, WATER, and FOOD, prepared according to the instructions of E. A. PARKES, Esq., M.D., Author of a "*Manual of Practical Hygiene*." Size of the divided Cabinet 27 inches in length, 11 inches in width, and 7 inches in depth, with lock and key, Price £9 5s.
4844. The SAME COLLECTION, without the balance, in a Cabinet measuring 23 inches in length, 11½ inches in width, and 6½ inches in depth, Price £7 7s.

CONTENTS AS FOLLOWS:—

- | | |
|---|---|
| Hydrometer, Scale .950 to 1.200, brass electro-gilt, in paper box. | 1953. Vulcanized Rubber Tube:—
¾ inch bore, 6 feet
¾ inch bore, 2 feet |
| 2780. Flask to hold 50 C. Cubes. | 1626. Box with 200 Filters, 3¾ inch |
| 429. Balance in Mahogany box. When loaded with 25 Grammes, it shows 1 Milligramme | 1950. Vulcanized Rubber Caps, 1 inch with 2 necks, 4 |
| Gramme Weights, 5, 2, 1, 1 Gramme, brass, and .5 Gramme to 1 Milligramme in platinum | Stoppered Bottles, flint glass, 4 ounce,
Wide mouth Stoppered Bottles, 3 ounce
16 |
| 860. Spirit Lamp with rack | THE FOLLOWING SOLID CHEMICALS:— |
| 2688. Mohr's Burette, 25 CC. in ½ CC. | Potass. Ferridcyanide, 1½ oz. |
| 2688. Mohr's Burette, 10 CC. in ⅓ CC. 2 copies | — Ferrocyanide, 2 oz. |
| Jets for Burettes, 2 extra | — Permanganate, 2 oz. |
| 2799. Mixing Bottle, 6 ounce, flat stopper | — Chromate, 2 oz. |
| Support for Burettes, &c., consisting of Brass rod, 2 clamps, jet holder, 3 rings, with screw to attach it to the Box | Ammon. Oxalate, 1 oz. |
| 1743. Porcelain Basin, 4¾ inch | Copper Sulphate, 2 oz. |
| 1239. Porcelain, 4½ inch Water Bath | Barium Chloride, 2½ oz. |
| 1323. Porcelain Crucible, 2¼ inch | — Nitrate, 3 oz. |
| 2875. Vogel's Milk Tester | — Hydrate, 2 oz. |
| Stirrers, 6 and 9 inch, 2 each | Silver Nitrate, 2 oz. |
| 2400. Test Tubes, 6 by ⅝ inch, 6 | Sodium Phosphate, 2 oz. |
| 423. Blue Litmus Paper, 6 books | — Carbonate Anhyd., 2 oz. |
| 423. Turmeric Paper, 6 books | Oxalic Acid, 1½ oz. |
| 2426. Box of Test Papers | Iron Sulphide, 6 oz. |
| | — Protosulphate, 2 oz. |
| | Soft Soap, 2 oz. |
| | Gold Chloride, 54 grains. |

4845. ENGINEERS' CHEMICAL CABINET: a Comprehensive Collection of CHEMICAL APPARATUS and TESTS, suitable for the performance of the QUALITATIVE ANALYSIS of Ores, Minerals, and most Chemical and Mineral Compounds, the whole selected of small sizes for the sake of portability, but of the best quality; contained in a divided Mahogany Cabinet, fitted with drawer and trays, size of the Cabinet—25½ inch long, 17 inches broad, and 11 inches deep. Price £10 10s.

CONTENTS:—

- | | |
|-----------------------------------|------------------------------------|
| 437. Balance and Grain Weights | 4204. Brass Blowpipe |
| 478. Graduated Measure, 2 oz. | Extra Jet for ditto |
| 4399. Steel Crushing Mortar | 1320. Platinum Crucible, ¾ inch |
| 50. Agate Mortar, 2 inch | 4232. Blowpipe Lamp |
| 62. Porcelain Mortar, 2½ inch | 4241. Brass Stand for ditto |
| 4404. Steel Spatula, 4 inch | 4397. Blowpipe Anvil |
| 177. Round File in Handle | 4395. Blowpipe Hammer |
| 4422. Triangular File in Handle | 4282. Platinum Blowpipe Tongs |
| 851. Glass Spirit Lamp, 3 oz. | 4409. Albata Test Spoon |
| 864. Cotton Wick for Lamp | 4270. Platinum Blowpipe Wires (2) |
| 4410. Tongs to trim Lamp | 4277. Platinum Blowpipe Foil (2) |
| 287. Retort Stand, 3 brass rings | 92. Iron Spoons (2) |
| 1323. Porcelain Crucible, 1¼ inch | 1741. Platinum Capsules ¼ inch (2) |
| „ Ditto 1¾ inch | 130. Spring Tongs to hold ditto |
| 1800. Porcelain Cups, 8 assorted | 4276. Fine Copper Wire, 12 inches |

S45. ENGINEERS' CHEMICAL CABINET, *continued*—

21. Charcoal Pastilles, 6 dozen	1626. Glass Funnel, 2, 2½, 3 inch
276. Stoppered Bottle for ditto	1677. Round Glass Covers, 3, 4 inch
22. Iron Mould to make Pastilles	Glass Funnel slight, 1 inch
207. Bottle of Charcoal Powder	342. Funnel Holder, blackwood
207. Bottle of Rice Powder	1610b. Filter Rings, Porcelain (2)
20. Porcelain Crucibles for Pastilles (2)	1625. Cut Filters, 2¼ inch (100)
21a. Wire Supports for ditto (2)	„ Ditto 3¾ inch (100)
49. Support for Sublimates	„ Ditto 4½ inch (100)
63. Narrow Test Tubes, 3 to 1½ inch (12)	1719. Berzelius's Washing Bottle
39. Magnifying Lens in horn case	1690. Straight Pipette, 6 inch
60. Open Glass Tubes, 6 by ⅝ inch (24)	2400. Test Tubes, 6 by ⅝ inch (6)
14. Iron Tongs and Spoon Handle	„ Ditto 6 by 1 inch (2)
75. Arsenic Tubes in a box	„ Ditto 4 by ½ inch (6)
84. Set of 4 Beaked Tumblers	359. Test Tubes Frame, 6 holes
45. Set of 6 Beakers	387. Test Tube Holder
00. Boiling Flasks, 3 to 5 oz. (6)	158. Test Tube Brush
85. Watch Glasses, 2 inch (2)	2426. Box of Test Papers
03. Watch Glass Holder	2436. Box of Test Metals
90. Porcelain Capsule, with Handle	1743. Porcelain Basin, 2¾ inch
91. Ditto larger	„ Ditto 3½ inch
95. Clark's Gas Bottle	„ Ditto 4 inch
15. Clark's Retort and Receiver	115. Glass Stirrers, 6 inch (6)
32. Glass Tube, ½ lb. assorted	

SIXTY STOPPERED GLASS BOTTLES FOR PURE CHEMICAL TESTS, namely, 20 of 2 ounce, and 13 of 1 ounce, with narrow mouths for *solutions*, and 27 of 1 ounce with wide mouths for *dry tests*. contents as follows:—

Acetic Acid	Iron Perchloride, <i>solution</i>	Potassium Cyanide
Ammonium, Caustic	Indigo Sulphate, <i>sol.</i>	— Sulphocyanide, <i>solution</i>
— Carbonate	Lead, Acetate, <i>sol.</i>	— Ferridcyanide, <i>sol.</i>
— Carbonate, <i>solution</i>	— Nitrate	— Ferrocyanide
— Chloride, <i>sol.</i>	Magnesia, Sulphate, <i>sol.</i>	— Ferrocyanide, <i>sol.</i>
— Molybdate, <i>sol.</i>	Manganese, Peroxide	— Hydrate
— Oxalate	Mercury, Perchloride	— Iodide
— Sulphide, <i>sol.</i>	— Protonitrate	— Nitrate
Barium, Chloride	Nitric Acid	Silver, Nitrate, <i>sol.</i>
— Chloride, <i>sol.</i>	Oxalic Acid	Sodium, Carbonate
— Hydrate	Platinum Chloride, <i>sol.</i>	— Carbonate, <i>sol.</i>
Barium, Hydrate	Potassium, Antimoniate, <i>sol.</i>	— Hydrate
Bismuth, Nitrate, <i>sol.</i>	— Bisulphate	— Phosphate, <i>sol.</i>
Copper, Sulphate	— Carbonate	— Sulphate
— Sulphate, <i>sol.</i>	— Carbonate, <i>sol.</i>	— Sulphate, <i>sol.</i>
Ells, Tincture	— Bicarbonate	Sulphuric Acid
Hydrochloric Acid	— Chromate	Tartaric Acid
Iron, Protosulphate	— Bichromate	Tin Protochloride
— Protosulphate, <i>sol.</i>	— Bichromate, <i>sol.</i>	Zinc in rods

Thirteen turned WOODEN BOXES, containing the following BLOWPIPE REAGENTS:—

Barium	Potassium Oxalate	Silica
Fluorapatite	Fluorspar	Boracic Acid
Microcosmic Salt	Gypsum	Metallic Lead
One Ashes	Nickel Soda-borate	Metallic Iron
Potassium Nitrate		

S45a. The "ENGINEER'S CHEMICAL CABINET" described above, was first prepared to meet suggestions of the late Sir HENRY DE LA BECHE, who spoke of it as follows, in a Section on Mineralogy, which he wrote for the "*Admiralty Manual of Scientific Enquiry*," Edited by Sir John F. W. Herschell:—

"It is probable that to CHEMICAL COMPOSITION the Voyager will chiefly look for aid [in the description of ORES and MINERALS], more especially if he be a Medical Officer, and therefore likely to have become sufficiently acquainted with Chemistry for the purpose. The modes of investigation will readily present themselves to one so qualified, and we would suggest that no surveying Voyage should be sent, more particularly to distant countries, without one of those Little Chests of NEEDFUL THINGS for CHEMICAL RESEARCH which are prepared for the purpose.

"GRIFFIN (of LONDON) and others fit up very compact and useful Chests of this kind. They necessarily vary in price according to their contents. For about £8, a chest of about 1½ cubic

4845. ENGINEERS' CHEMICAL CABINET, *continued*—

feet, not a cumbrous size for a cabin, may be obtained. It would contain apparatus and substances sufficient for discriminating all well-known ores and minerals, including a Blowpipe Apparatus with the necessary Fluxes and Reagents, as also a selection of the most useful instruments for testing in the wet way, with a collection of tests in the dry state, and stoppered bottles to contain solutions; also a set of bottles with pure acids.

“More complete Chests may be obtained for about £15 or £16; far more valuable for long voyages, during which deficiencies cannot be expected to be supplied. These are divided into two chests, one containing the things needful for more constant, the other large articles for occasional use, as well as duplicates of apparatus liable to be broken, with an extra stock of chemicals. These chests usually occupy about 4 cubic feet, and contain apparatus and chemicals sufficient for the complete Quantitative Analyses of Minerals, or the separation of the component parts of a mineral, in quantities sufficient for an accurate analysis. They include platinum crucibles, Bohemian test tubes, Berlin porcelain crucibles and capsules, complete blowpipe apparatus, &c., &c. — *Admiralty Manual of Scientific Enquiry*, page 245.

4846. APPARATUS and TEST SOLUTIONS for the CHEMICAL TESTING of WINE and SPIRITS, according to Processes that are fully described in the work called “*The Chemical Testing of Wines and Spirits*. By JOHN J. GRIFFIN F.C.S.”

The Collection comprises a Balance, set of Grain Weights, Specific Gravity Bottle and Thermometer; also, a Distilling Apparatus and a set of Apparatus and Volumetric Test Solutions for estimating experimentally the percentage of alcohol, free acid, distinguishing volatile from fixed acid, sugar extract, ash, and alkaline salts in wines and spirits of all descriptions.

4846. Price of the complete collection, £9 9s.

4847. Price of the collection, without the Balance and Set of Weights, £6 6s.

GROUP VII.—*Collections of Apparatus for the use of Lecturers and Schoolmasters Nos. 4861 to 4866.*4861. AGRICULTURAL CHEMISTRY. GRIFFIN'S COLLECTION of CHEMICAL APPARATUS and PREPARATIONS, for the Performance of the EXPERIMENTS requisite to demonstrate the Chemical Facts contained in PROFESSOR JOHNSTON'S *Catechism of Agricultural Chemistry and Geology*. Adapted for the use of Schoolmasters. Price £1 11s. 6d., packed in a case.

To Messrs. GRIFFIN and Co.,

AGRICULTURAL CHEMISTRY ASSOCIATION,
8, Baker Street, Edinburgh, 23rd July, 1844.

GENTLEMEN,—I am much obliged to you for the trouble you have taken in making up a set of Apparatus suited to the EXPERIMENTS mentioned in my *Catechism of Agricultural Chemistry and Geology*. I think it is very complete, and excellent, and I am sure that the Schoolmasters in general will feel as grateful to you as I do myself.

Believe me, yours truly,

(Signed) JAMES F. W. JOHNSTON.

CONTENTS :—

1192.	Spirit Lamp, stoneware	2237.	Crook and Cork for ditto
1193.	Oil Lamp, stoneware	1559.	Bottle for HSO^2 , $\frac{1}{2}$ pint stoppered
864.	Cotton Wick, 2 feet	1559.	Bottle for HCl , $\frac{1}{2}$ pint stoppered
1191.	Lamp Cylinder, 6 inch	2066.	Pneumatic Trough, 11 inch
1196.	Trellis Top, for ditto	2071.	Beehive Shelf, 4 inch
1194.	Pair of Ring Tops, ditto	1576.	Glass Bottle, $\frac{1}{2}$ pint, stoppered
1963.	Hydrogen Gas Bottle, 1 tube	1535.	Jar, 10 by 3 inch, No. 28
2254.	Jet and Cork for ditto	1535.	Jar, 6 by 2 $\frac{1}{2}$ inch, No. 20
2033.	Chlorine Gas Bottle, 1 tube	2101.	Deflagrating Jar, 5 inch
2014.	Oxygen Gas Retort and Tube	2299.	Deflagrating Spoon
2014.	Extra Retort for ditto	2232.	Wire and Taper
2400.	Test Tubes, 3 by $\frac{1}{2}$ inch (2)	160.	Tray for Gas Jar, 3 inch
	4 by 1 inch (2)	160.	Tray for Gas Jar, 4 inch
2423.	Book of Litmus Paper	2417.	Test Glass, 6 ounce, cylindrical
2423.	Book of Turmeric Paper	2410.	Test Glass, 3 ounce, conical
293.	Tube Holder, with Stand	115.	Glass Stirrers, 3 and 6 inch

61. JOHNSTON'S AGRICULTURAL CHEMISTRY, *continued*—

90. Pipette, plain, 6 inch
 31. Open Tubes, 2 sizes
 90. Porcelain Capsule and Handle
 35. Iron Tongs, with Spoon
 62. Mortar and Pestle, $2\frac{1}{4}$ inch
 70. Porcelain Basin, 4 inch
 26. Glass Funnel, $1\frac{1}{2}$ inch
 26. Filters, 100, $2\frac{3}{4}$ inch
 10. Filter Ring

CHEMICALS in Bottles :—

- Zinc Punchings, 6 oz.
 Manganese Peroxide, 8 oz.
 Potassium Chlorate, 4 oz.
 Mercuric Oxide, $\frac{1}{2}$ oz.
 Potassium Nitrate, 2 oz.
 Phosphorus, 2 drachms
 Cupric Oxide, 1 oz.

Packing Case

The following article, No. 4826, describes a superior Collection of Apparatus for the above-mentioned purpose.

62. COLLECTION of CHEMICAL APPARATUS and TESTS, for performing the Experiments described in JOHNSTON'S "*Catechism of Agricultural Chemistry*;" also, suitable for LECTURES on the NON METALLIC ELEMENTS before a School, or other limited Audience. Contained in a portable divided cabinet, of pine wood, stained black, measuring 25 inches in length, 18 inches in width, and 13 inches in depth. Price £4 14s. 6d.

CONTENTS :

- | | |
|---|---|
| 62. Porcelain Mortar, No. 0 | 1805. Retort, plain, 4 oz. |
| 64. Set of 5 Beakers, 0 to 4 | 1847. Receiver, stoppered, 4 oz. |
| 51. Glass Spirit Lamp, 4 oz. | 2254. Cork and Jet for Gas Bottle |
| 64. Cotton Wick, 1 yard | 1576. Bottle, 10 oz., wide mo. stoppered |
| 91. Lamp Cylinder, 6 inch | 2232. Wire and Taper |
| 95. Pair of Hot Plates, tin plate | 1626. Funnels, 1 ea. 2 and 3 inch |
| 94. Pair of Iron Ring Tops | 1626. Filters, 100 each to fit the funnels |
| 96. Iron Trellis Top | 342. Funnel Holder, blackwood |
| 100. Water Bath, 2 pieces | 293. Tube Holder, fitted to do. |
| 97. Sand Bath, 5 inch, tin plate | 387. Test Tube Holder, in handle |
| 101. Tube Support on stand | 287. Retort Stand, 3 brass rings |
| 77. Graduated Measure, 1 oz. | 359. Tube Frames, 6 holes |
| 37. Balance and Grain Weights | 2400. Test Tubes, 6 of 5 by $\frac{1}{8}$ in. |
| 104. Flasks, green, 4 and 8 oz. | Ditto 6 of 5 by $\frac{3}{8}$ in. |
| 100. Flasks, white, 6 and 10 oz. | 1690. Straight Pipettes, 6 inch (2) |
| 43. Porcelain Basin, $3\frac{1}{2}$ inch | 115. Stirrers, 2 ea. 3, 6, 9 inch |
| Ditto ,, 4 inch | 2426. Box of Test Papers |
| Ditto ,, $4\frac{1}{4}$ inch | 2438. Albata Test Spoon |
| 66. Semiporcelain Basin, 5 inch | 1786. Pair of Watch Glasses |
| 119. Test Glass, 12 oz., cylindrical | 403. Watch Glass Holder |
| 110. Test Glass, conical (3) | 1800. Porcelain Cups, $1\frac{1}{2}$ inch |
| 88. Conical Glass Jar, $\frac{1}{4}$ pint | 1790. Porcelain Capsule with handle |
| 21. Glass Jars, set of 4, $2\frac{1}{2}$ to 5 inch | 1323. Porcelain Crucible, $1\frac{1}{2}$ inch |
| 63. Hydrogen Gas Bottle, $\frac{1}{2}$ pint, 1 tube | Ditto $1\frac{3}{4}$ inch |
| 96. Clark's Gas Bottle | Ditto $2\frac{1}{2}$ inch |
| 114. Oxygen Retort and Tube | 1610. Filter Rings, 2 sizes |
| 101. Deflagrating Jar, 5 inch | 99. Steel Spatula, 5 inch in handle |
| 29. Deflagrating Spoon, No. 1 | 4200. Blowpipe |
| 71a. Beehive Shelf, 4 inch | 135. Iron Tongs with spoon |
| 60. Gas Tray, 4 inch | 4277. Platinum Foil, 2 by $\frac{1}{2}$ inch |
| 60. Gas Tray, $4\frac{1}{2}$ inch | 4270. Platinum Wire, 2 inch (2) |
| 09. Retort, stoppered, 4 oz. | 1741. Platinum Capsule, $\frac{1}{4}$ inch |

BOTTLES CONTAINING CHEMICAL PREPARATIONS.

- | | | |
|-----------------------------|--------------------------------------|-----------------------------------|
| Wide Mouth, 1 oz. stoppered | Barium, Chloride, 2 oz. | Potassium Carbonate, 1 oz. |
| Narrow Mouth, 1 oz. ,, | Nitrate, 2 oz. | Chlorate, 4 oz. |
| Wide Mouth, 2 oz. corked | Copper, Black Oxide, 2 oz. | Hydrate, 1 oz. |
| Ditto 4 oz. ,, | Calcium Chloride fused, 4 oz. | Nitrate, 4 oz. |
| CHEMICALS : | Hydrate, 4 oz. | Phosphorus, $\frac{1}{4}$ oz. |
| Acetic Acid, 1 oz. | Iron Protosulphate, 2 oz. | Sodium, Borate, 1 oz. |
| Ammonium, Cryst. 4 oz. | Sulphide, 4 oz. | Carbonate, $1\frac{1}{2}$ oz. |
| Ammonium Carbonate, 1 oz. | Magnesia Sulphate, 4 oz. | Phosphate, 1 oz. |
| Chloride, 3 oz. | Magnesia Calcined, $\frac{1}{2}$ oz. | Silica, in powder, 3 oz. |
| Nitrate, 2 oz. | Manganese Peroxide, 8 oz. | Tartaric Acid, $1\frac{1}{4}$ oz. |
| Oxalate, 1 oz. | Mercury, Red Oxide, 1 oz. | Zinc, Granulated, 6 oz. |

4863. COLLECTION of CHEMICAL APPARATUS SUITABLE for SCHOOL MASTERS. This is the Set prepared for Class Teaching in NATIONAL SCHOOLS, and described in the following work:—“*Special Report on Apparatus for Elementary Instruction in Science*; by the Rev FREDERICK TEMPLE M.A., *Her Majesty's Inspector of Schools*.” Education Office, Whitehall 11th July, 1856.

Considerable improvements in many of the Instruments have been made during the ten years passed since 1856, and the improved articles are contained in the following collection; but in the main the Set corresponds with that described in the above Report.

4863. Price of the Apparatus without the Chemicals, 18 guineas.

4864. Price, with the Chemicals enumerated, No. 4865, 21 guineas.

The marginal numbers refer to figures and descriptions given in the preceding pages of this work.

- | | | | |
|-------|---|---------|--|
| 1579. | Bottle, 6 pints, with stopper | 2249. | Balloon, 9 inch |
| 1766. | Porcelain Basin, 6½ inch | 2143. | Bladder with wood mouth-piece |
| 2232. | Wire and Taper (2) | 2136. | Waterproof Gas Bag |
| 2244. | Candle Holder | 2255. | Brass Tobacco Pipe for Gas |
| 2236. | Cup to hold Phosphorus | 1962. | Hydrogen Gas Bottle, 2 tubes |
| 2277. | Wire Gauze, 8 inches square | 2014. | Oxygen Tube Retort |
| 4360. | Open Glass Tubes, 6 by ¼ inch (3) | 2020. | Large Retort for Oxygen Gas |
| 2400. | Test Tubes, 6 by ¾ inch (6) | 1996. | Glass Bottle for Carbonic Acid |
| | Flexible Metal Pipe, 18 inches | 2053. | Chlorine Gas Bottle |
| 1575. | Bottles, 4 oz., corked (6) | 293. | Support for Small Retorts |
| 1579. | Bottles, pint, stoppered (2) | 391. | Tin Crook to Support hot Tubes |
| 1550. | Bottles, 3 oz., NM stoppered (24) | 2187. | U-tube Condenser |
| 1550. | Bottles, 6 oz., NM stoppered (24) | 1806. | Glass Retorts, plain, of 5, 10, 20, and 40 ounces (4) |
| 1677. | Glass Discs, 4 and 6 inch | 1809. | Glass Retorts, stoppered, 10 & 20 oz. (2) |
| 1400. | German Flasks, 8 oz. (2) | 1405. | Glass Receivers, plain, 8, 16, 24 oz. (3) |
| 851. | Glass Spirit Lamp | 1865. | Adapters, 1½ and 2 inch (2) |
| 1448. | Set of 10 Beaker Glasses | 1626. | Glass Funnel, 4 inch (2) |
| 2251. | Gas Bottle for Hydrogen | | 100 Filters for ditto and Box |
| 2251. | Tube for Musical Sounds | | Glass Funnel, 3 inch (2) |
| 2135. | Glass Cylinder, 10 by 2, open | | 100 Filters for ditto and Box |
| 2077. | Tate's Pneumatic Trough | | Glass Funnel, 2 inch (2) |
| 2067. | Griffin's Stoneware Trough | | 100 Filters for ditto and Box |
| 223. | Danger's Glassblower's Lamp | 342. | Funnel Holder, black wood |
| 228. | Iron Rod for Glassblowers | 907, 2. | Argand Oil Lamp |
| 2161. | Griffin's School Gasholder | 1219. | Griffin's Lamp Furnace, containing 17 articles |
| 2162. | Stopcock for use with ditto | 1743. | Porcelain Basins, 2¾, 3½, 4, 4¾, 7¾, and 8½ inches (6) |
| 1953. | Vulcanized Tube, ½ inch, 3 feet | 1790. | Porcelain Capsule with handle (2) |
| 1953. | Ditto, ⅓ inch, 3 feet | 2400. | Test Tubes, 3 by 1 inch (6) |
| 697. | Stopcock, double male (2) | | Ditto 5 by ⅝ inch (6) |
| 698. | Stopcock, male and female | | Ditto 6 by 1 inch (6) |
| 705. | Connector, double male | 2410. | Test Glass, conical, 1 oz. (12) |
| 704. | Ditto, double female | 2417. | Test Glass, cylindrical, 6 oz. (6) |
| 706. | Ditto, male and female | 158. | Brush to clean Test Tubes |
| 160. | Trays for Gas Jars, 2 to 7 in. (6) | 387. | Clip to hold hot tubes |
| 2122. | Gas Jar, 12 by 2 inches | 115. | Glass Stirrers, 3 inch (12) |
| 2329. | Ditto, graduated into 30 cubic inches | | Ditto 6 inch (6) |
| 2103. | Deflagrating Jar, 9 by 5 inches | | Ditto 9 and 12 inch (3 each) |
| 2104. | Ditto, 11 by 6 inches | 1785. | Watch Glasses (6) |
| 1576. | Quart Bottles stoppered (3) | 1953. | Vulcanized Tube, ¼ inch (1 foot) |
| 2224. | Globe for Phosphorus | | Ditto ⅓ inch (1 foot) |
| 2226. | Cup for Phosphorus | | Ditto ½ inch (1 foot) |
| 2227. | Pan 12 inch for ditto | 1592. | Chemical labels, small |
| 2230. | Brass Deflagrating Spoons (2) | 1593. | Ditto large |
| 2233. | Hank of Iron Wire | 1594. | Ditto De la Rue's |
| 2110. | Gas Jar with brass cap, 12 by 6 in. | 1400. | Glass Flasks, 8, 16, 20, and 32 oz. (4) |
| 2114. | Glass Globe for ditto | 1482. | Bohemian Beaked Tumblers, a set of |
| 920. | Gas Burner, gauze top, &c. | 480. | Graduated Measure, 10 oz. |
| 2241. | Oxygen Blowpipe Jet | | |
| 4522. | Set of Blowpipe Apparatus for testing Minerals, &c. | | |

303. CHEMICAL APPARATUS FOR NATIONAL SCHOOLS, *continued*—

- | | |
|--|---|
| <p>692. Dropping Tube with bulb
 690. Straight Pipettes (2)
 334. Jar on foot, 8 by 2 inch
 10 by 2 inch
 12 by 2 inch
 15 by 3 inch
 10 by 1½ inch
 12 by 1½ inch
 16 by 1¾ inch.
 360. Porcelain Cups (2)
 271. Retort Stand, 2 Rings, 1 Triangle
 359. Test Tube Stand, 6 holes
 371. Ditto 8 holes and pegs
 279. Tate's Oxyhydrogen Blowpipe
 195. Apparatus to produce Water from H. gas
 242. Respiration Apparatus
 245. To Collect CO² from burning Caudle
 246. Water Bottle with tap
 441. Balance to Weigh 1 lb
 459. Pound pile of Weights
 437. Balance and Weights for under ½ oz.
 783. Specific Gravity Bottle, 250 septems
 340. Ure's Eudiometer
 315. Clark's Retort and Receiver</p> | <p>1817. Faraday's Retort and Receiver
 1886. Still and Condenser
 1354. Set of 5 Hessian Crucibles
 1352. Melting Pots, small (6)
 1323. Porcelain Crucible, 1½ inch
 Ditto 1¾ inch
 Ditto 2¼ inch
 393. Set of 6 round wood Blocks
 62, 2. Porcelain Mortar, 4 inch
 170. Case of 6 Cork Borers
 177. Rat-tail File
 184. Half-round Rasp
 229. Triangular File
 168. Corks, assorted, 1 gross
 231. Glass Tubes, assorted, 2 lb.
 1396. Iron Ladles, 2 and 4 inch
 92. Iron Spoons (2)
 121. Crucible Tongs
 404. Stoneware Basin Supports (2)
 321. Universal Support
 313. Vertical Support
 2426. Box of Test Papers
 2432. Ditto for Lecturers</p> |
|--|---|

365. CHEMICAL PREPARATIONS, to accompany the above set of Apparatus, all in Glass Bottles, with glass stoppers, when necessary. Price without the Apparatus, £3 3s.

- | | | |
|---|---|--|
| <p>CIDS :—
 Sulphuric, comml., 1 pint
 Sulphuric, pure, ¼ lb.
 Hydrochloric, comml., 1 pint
 Hydrochloric, pure, ½ lb.
 Nitric, comml., ½ lb.
 Nitric, pure, ½ lb.
 Acetic, 2 oz.
 Oxalic, cryst., 1 oz.
 Tartaric, cryst., 1 oz.
 Alcohol, 6 oz.
 Gum, 4 oz.
 Ammonium Chloride, 2 oz.
 Ammonia Carbonate, 2 oz.
 Ammonia Caustic, 1 pint
 Ammonia Nitrate, 6 oz.
 Antimony Metallic, 1 oz.
 Antimony Sulphide, 4 oz.
 Arsenium Chloride, 1 oz.
 Arsenium Nitrate, 1 oz.
 Calcium Chloride, cryst., 2 oz.
 Calcium Carbonate, 4 oz.
 Calcium Hydrate, 2 oz.
 Calcium Fluoride, 2 oz.
 Leaching Powder, 4 oz.
 Amphor, 1 oz.
 Charcoal Sticks, 2 oz.
 Charcoal Powder, 2 oz.
 Cobalt Chloride, ½ oz., solution
 Cobalt Nitrate, ½ oz., solution
 Cochineal, 1 oz.</p> | <p>Copper Leaf, 24 leaves
 Copper Turnings, 2 oz.
 Copper Nitrate, 1 oz.
 Copper Sulphate, 4 oz.
 Copper Chloride, ½ oz.
 Gall Nuts Powder, 1 oz.
 Gold Leaf, ½ book of 25 leaves
 Indigo, 1 oz.
 Iodine, ½ oz.
 Iron Perchloride, 1 oz.
 Iron Persulphate, 1 oz.
 Iron Protosulphate, 4 oz.
 Iron Protosulphate, pure, 2 oz.
 Iron Sulphide, ½ lb.
 Lead Metallic, 1 oz.
 Lead Red Oxide, 1 oz.
 Lead Litharge, 1 oz.
 Lead Acetate, 4 oz.
 Lead Acetate, pure, 2 oz.
 Lead Carbonate, 1 oz.
 Lead Ore, Galena, 2 oz.
 Litmus, ½ oz.
 Lycopodium, ½ oz.
 Magnesium Oxide, 1 oz.
 Magnesium Carbonate, 1 oz.
 Magnesium Sulphate, 2 oz.
 Manganese Peroxide, 1 lb.
 Naphtha for burning, 1 pint
 Mercury Metallic, ¼ lb.
 Mercury Perchloride, ½ oz.
 Phosphorus, 1 oz.</p> | <p>Phosphorus Amorphous, ½ oz.
 Potassium Metallic, 6 grains
 Potassium Bromide, ¼ oz.
 Potassium Bichromate, 1 oz.
 Potassium Bitartrate, 1 oz.
 Potassium Carbonate, 2 oz.
 Potassium Carb., purif., 1 oz.
 Potassium Chlorate, ½ lb.
 Potassium Chromate, 1 oz.
 Potassium Ferridecyanide, ½ oz.
 Potassium Ferrocyanide, 1 oz.
 Potassium Hydrate, ½ oz.
 Potassium Hydrate, pure, ½ oz.
 Potassium Iodide, 1 oz.
 Potassium Nitrate, 4 oz.
 Potassium Sulphocyanide, ¼ oz.
 Silver Leaf, 25 small leaves
 Silver Nitrate, 2 drachms
 Sodium Metallic, 10 grains
 Sodium Borate (Borax) 2 oz.
 Sodium Bicarbonate, 1 oz.
 Sodium Carbonate, cryst., 2 oz.
 Sodium Nitrate, 2 oz.
 Sodium Sulphate, 4 oz.
 Stourbridge Clay, ½ lb.
 Strontium Nitrate, ½ oz.
 Sulphur Roll, 2 oz.
 Sulphur Sublimed, 2 oz.
 Tinfoil, 1 oz.
 Tin Chloride, ½ oz.
 Zinc Cuttings, ½ lb.</p> |
|---|---|--|

4866. COLLECTION OF APPARATUS suitable for EXPERIMENTS to ILLUSTRATE SHORT COURSE of POPULAR LECTURES on CHEMISTRY, consisting of Instruments that are in general of larger size than those forming the preceding collection. Price £21.

CONTAINING THE FOLLOWING INSTRUMENTS :—

For Pulverisation :—

- 62, 1. Porcelain Mortar, $3\frac{1}{4}$ inch
- 62, 3. ditto 5 inch
- 44, 2. Iron Mortar, 6 inch
- 99. Steel Spatula, 6 inch

For Solutions :—

- 1400. Glass Flasks, 2 each of 4, 6, 8, 10, 16, 20, 24, 30, 40, and 80 ounce
- 1468. Set of 8 Beaker Glasses
- 1482. Set of 6 Beaked Tumblers

Furnaces, &c. :—

- 805. Evaporating Furnace, 7 inch
- 790. Universal Furnace with appurtenances, 12 articles
- 1219. Griffin's Lamp Furnaces, 17 articles, complete
- 870. Brass Argand Spirit Lamp with Stand and Fittings
- 863. Wick for small lamp, 12 yards
- 866. Wicks for Argand Lamp, 24
- 132. Brass Tongs to trim Lamp
- 135. Iron Tongs, spoon handle
- 133. Iron Tongs, without spoon

Supports for Apparatus :—

- 297, 1. Tripod Support
- 293. Tube Holder
- 333. Table Support, with Crook
- 337. Crook for Tubes
- 393. Set of 6 Round Blocks
- 262. Strong Retort Stand, 3 rings
- 319, 3. Bunsen's Universal Clamp Support
- 315. Hinged Clamp support

For Testing :—

- 2404. Assortment of 60 Test Tubes, 5 to 7 inch
- 360. Frame for 12 tubes, without pegs
- 371. Frame for 8 tubes, with pegs
- 388. Holder for hot Test Tubes
- 158. Test Tube Brush
- 2410. Conical Test Glass, 12
- 115. Glass Stirrers, 3 inch, 12
- 115. Ditto 6 „ 6
- 115. Ditto 9 „ 6
- 98. Albata Test Spoon
- 2441. Porcelain Testing Plates, 2
- 2426. Box of Test Papers
- 2432. Box of ditto, large size
- 2436. Box of Test Metals
- 1690. Straight Pipettes, 3
- 1691. Bulb Pipettes, 2
- 2856. Schuster's Dropping Bottle
- 477. Graduated Measure, 1 ounce
- 479. Ditto 5 „
- 481. Ditto 1 pint

For Filtration :—

- 1627. Set of 7 Funnels, 1 to 4 inch
- 1028. Seven Filter Boxes.
- 1628. 100 Filters each, 7 sizes

- 1595. Funnels of 4, 6, 8 inch
- 343. Funnel Holder, 2 arms
- 348. Ditto, 1 arm, large size
- 1610. China Filter Ring, 2 arms
- 1611. Ditto 3 arms
- 1719. Washing Bottle, 1 jet
- 1725. Ditto 2 tubes
- 254. Water Bottle, to fill tubes
- 1677. Glass Covers, 3, 4, 5 inch (6)
- 1531. Jar with Spout, 4 pints

For Evaporation :—

- 1747. Porcelain Basins, $2\frac{3}{4}$ inch, $3\frac{1}{2}$ inch, $3\frac{3}{4}$ inch, $4\frac{1}{2}$ inch, 6 inch, 10 inch diameter
- 1540. Stoneware Conical Pans, 8, 10, 12 inch
- 1766. Semi-porcelain Basin, 12 inch
- 1768. Ditto, set of 6 small sizes
- 1790. Porcelain Capsule with Handle
- 1795. Semi-porcelain Capsule with Handle and Spout, 4 inch and $5\frac{1}{4}$ inch
- 1800. Thin Capsules for weighing, 2
- 404. Biscuit Basin Stand, 2

For Ignition :—

- 1323. Porcelain Crucible, $2\frac{1}{4}$ inch, 2
- 1324. Ditto, Cylindrical, 2 sorts
- 1354. Nest of 5 Hessian Crucibles
- 1800. Porcelain Cups, six
- 120. Charcoal Tongs, 16 inch
- 121. Crucible Tongs, bright
- 4201. Blowpipe
- 4230. Blowpipe Lamp on Stand
- 1741. Platinum Cup, $\frac{1}{4}$ inch
- 4283. Spring Steel Tongs
- 4376. Box of 15 Arsenic Tubes

For Distillation :—

- 1806. Retorts, plain, 4 ounce, 10 ounce, 16 ounce, 2 each
- 1809. Retorts, Stoppered, 4 10, 20, 40 ounce
- 1815. Clark's Retort and Receiver, 2
- 1817. Faraday's Retort
- 1942. Safety Funnel
- 1849. Glass Receiver, 2 necks, 5 ounce
- 1849. Ditto ditto 10 ounce
- 1405. Receivers, plain, 4, 10, and 20 ounce, 2 each
- 1847. Receivers, stoppered, 10, 20, and 40 ounce, 1 each
- 1865. Adapters, 2 inch, two
- 1875. Improved Condenser
- 1876. Support for Condenser
- 246. Two-gallon Water Bottle, with brass tap

For Experiments on Gases :—

- 1962. Bottle for Hydrogen Gas
- 1963. Ditto, without Funnel.
- 1964. Ditto, with Wash Bottle
- 1996. Bottle for HS Gas

366. APPARATUS FOR POPULAR LECTURES ON CHEMISTRY, *continued*.

014. Retort for Oxygen Gas	2125. Gas Tubes, 3 assorted.
033. Bottle for Chlorine Gas	2122. Eprouvettes 6 by $1\frac{1}{2}$ inch, 2
034. Jar on foot, 9 by 2 inches	„ 9 by $1\frac{3}{4}$ „ 2
034. Jar on foot, 12 by 3 inches	„ 12 by 2 „ 2
035. Glass Covers, 3 and 4 inch	„ 11 by 3 „ 2
032. Woulff's Bottle, 3 necks, pint	2142. Bladder with brass Collar
003. Deflagrating Jar, 9 by 5 inch	697. Stopcock to fit ditto
004. Ditto 11 by 6 inch	2255. Brass Tobacco Pipe
010. Bell Jar, 12 by 6 inch, with Globe and Brass Fittings, figs. 2110 and 2112.	2241. Brass Blowpipe for Oxygen
024. Oxygen Globe, for combustions	2279. Tate's Oxyhydrogen Blowpipe
026. Cup for Phosphorus	2310. For the Explosion of Oxyhydrogen Gas
029. Iron Deflagrating Spoon	2245. Carbonic Acid Gas from flame
030. Brass ditto	2195. Water from burning Hydrogen
048f. Chlor-Calcium Tube	2249. Balloon, 9 inch
049c. Ditto ditto	2252. Philosophical Candle
059. Reduction Tube, 1 bulb, straight	2253. Tube for Musical tones
062. Ditto 2 bulbs, bent	2265. Water from Oxide of Copper
061. School Gas Holder	2277. Iron Gauze for Davy's Lamp
075. Pneumatic Trough, 19 by $12\frac{1}{2}$ inch, Japanned	2317. Gas distilled from coal
066. Stoneware Trough, 11 inch	2316. Vinegar distilled from wood
066. Beehive Shelf, 4 inch	1953. Caoutchouc connectors, 12
087. Trough for Mercury	231. Glass Tube for Gases, 2 lb.
093. Tray for ditto, 12 inch	229. File to cut Glass Tubes
032. Pair of Tapers on Wires	<i>Sundries:—</i>
033. Hank of Iron Wire to burn	170. Set of 6 Cork Borers
060. Trays, 3, 4, 5, 6 inch, for Jars	177. Round File, 4 inch
005. Deflagrating Jar with Cap and Flexible Tube	179. Ditto 6 inch
020. Bottles, Stoppered, 2 pints, 2	186. Flat Rasp, 4 inch
020. Ditto 4 pints, 1	188. Round Rasp, 4 inch
024. Gas Tubes, 6 assorted.	1592. Set of Chemical Labels
	1593. Another Set, larger

GROUP VIII.—*Portable Cabinets of Blowpipe Apparatus* (already fully described at the numbers referred to).

A. SETS FOR QUALITATIVE ANALYSIS:—

No. 4521, 10s. 6d.	No. 4525, 52s. 6d.	No. 4523, 73s. 6d.
„ 4522, 21s.	„ 4524, 63s.	„ 4527, 105s.

B. SETS FOR QUANTITATIVE ANALYSIS:—

No. 4529, £24.	No. 4530, £18.
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GROUP IX.—*Collections of Graduated Apparatus and Test Solutions for Volumetric Analysis in various branches* (already fully described at the numbers referred to).

A. VOLUMETRIC APPARATUS FOR GENERAL USE:—

No. 2896, set A, £7.	No. 2898, set C, £2 2s.
„ 2897, set B, £3 10s.	„ 2899, set C, £1 1s.

B. VOLUMETRIC APPARATUS ACCORDING TO THE BRITISH PHARMACOPŒIA:—

No. 2890, set of Solutions, 14s.	No. 2891, set of Instruments, 31s. 6d.
----------------------------------	--

C. VOLUMETRIC APPARATUS FOR URINOMETRY :—

4072. Set of Test Solutions after NEUBAUER, 48s.
 4074. Set of Apparatus after NEUBAUER, 84s.
 4075. Limited set of Apparatus after NEUBAUER, 42s.
 4101. Test Solutions for the Qualitative Analysis of Urine, 13s.
 4107. Apparatus and Test Solutions for the Quantitative Analysis of Urine, according to LIEBIG (Beale's arrangement), £3 3s.
 4108. The same in a Cabinet, £4 4s.
 4109. Apparatus and Test Solutions for the Quantitative estimation of Diabetic Sugar, after PAVY, 21s. 9d.
 4119. Apparatus and Tests for the Qualitative Analysis of Urinary Deposits, after GOLDING BIRD, 30s.
 4120. The same in a Mahogany Cabinet, 52s. 6d.
-

GROUP X.—*Sets of Apparatus for Analytical Processes in Metallurgy.*

2889. For the Volumetric Assay of Zinc Ores, 21s.
 For the Assay of Copper Ores.
 4540. For the Assay of Gold and Silver by the operation of Cupellation.
 4580. For the Assay of Silver in the Wet Way.
 4625. For estimating the percentage of Gold in Crushed Quartz, in the Wet Way.
-

GROUP XI.—*Miscellaneous Collections.*

2872. Clark's Water Test. See page 315.
 2882. Shier's Sugar Test. See page 319.
 Alkalimetry, Acidimetry, Chlorimetry; Sets of Graduated Instruments and Test Solutions for these and similar branches of chemical testing prepared to order; the graduation of the Instruments being in Septems, Decems, or Centimetre Cubes, as may be desired.

4867. COLLECTIONS of APPARATUS for QUANTITATIVE CHEMICAL ANALYSIS.

Quantitative Analysis is so wide a subject, that it cannot be properly treated in restricted limits. Every chemist, whether engaged in original researches, or employed in technological pursuits, follows a course peculiar to himself, and requires Apparatus and Chemicals which he must himself choose as suitable for his special purposes. It is hoped that the details given in this work, under the several heads into which it is divided, afford all the information which may be expected required on the respective subjects.

Collections of Specimens of Minerals
Illustrative of Mineralogy, Geology, and Metallurgy.

These Collections comprise Specimens from all parts of the world. They are well assorted ; so as to exhibit perfectly clean surfaces ; and all neatly cut to uniform sizes. The more expensive Collections contain Specimens of considerable rarity and elegance, while such a principle of selection has been constantly followed, that even the cheapest collections present those Minerals with which it is most important for the student to become earliest acquainted. The specimens exhibit distinctly, in all cases, the characters whereby the various substances are discriminated, and the collections are accompanied by catalogues, or by tickets with all the specimens, which state the NAME and LOCALITY of every specimen.

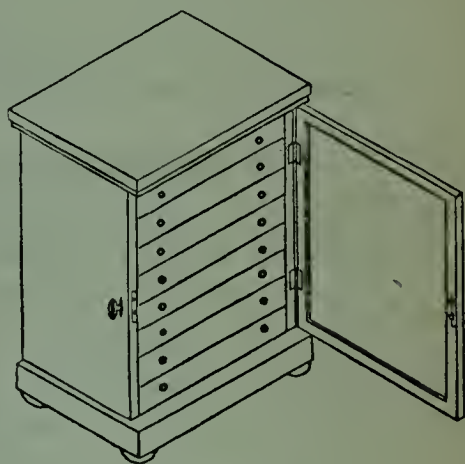
A. Collections of Specimens in Cabinets.

LEMENTARY COLLECTIONS of MINERALS and ROCKS in MAHOGANY
CABINETS.

The five following Collections are contained in handsome finished Mahogany Cabinets, opening with a door or a pair of doors, and containing mahogany drawers. Every specimen placed in a separate pasteboard tray, covered with scented green paper. Size of specimens from two to three square inches.

The Cabinets for 100 specimens have 4 drawers ; those for 50 specimens have 6 drawers ; and those for 200 specimens have 8 drawers ; as represented by Fig. 4884.

80. Cabinet of 100 Simple Minerals	£2 10 0
81. Cabinet of 100 Rocks and Fossils	2 10 0
82. Cabinet of 150 Simple Minerals	3 13 6
83. Cabinet of 150 Rocks and Fossils	3 13 6
84. Cabinet of 200 Minerals, Rocks, and Fossils	4 14 6



4884.

LEMENTARY COLLECTIONS of MINERALS and ROCKS, in STRONG
PASTEBOARD CABINETS.

These Pasteboard Cabinets have divided Trays. Those for 100 specimens have 4 trays; those for 150 specimens have 5 trays.

The size of the specimens of Minerals in these Cabinets is 2 square inches.

885. Cabinet of 100 Simple Minerals	..	..	..	..	..	£1 11 6
886. Cabinet of 150 Simple Minerals	..	..	..	..	..	2 10 0
887. Cabinet of 100 Rocks	..	..	..	..	..	1 11 6
888. Cabinet of 150 Rocks	..	..	..	..	..	2 10 0
889. GRIFFIN'S ELEMENTARY CABINET OF SPECIMENS FOR BE-						

389. GRIFFIN'S ELEMENTARY CABINET OF SPECIMENS FOR BEGINNERS IN THE STUDY OF MINERALOGY, GEOLOGY, AND CRYSTALLOGRAPHY. A pasteboard divided Cabinet with 50 Minerals, 50 Rocks, and 20 Models of Crystals, and an Elementary Treatise on these sciences, describing every specimen in the collection, £2.

4890. Collection of 100 SPECIMENS OF MINERALS; size from one to two square inches in 100 round trays, arranged in two large square trays in a Pasteboard Cabinet, size of the latter $15\frac{1}{2}$ inches long, $12\frac{1}{2}$ inches wide, 3 inches deep, price 18s.
4891. Collection of 54 MINERALS, size one square inch, in 54 round trays, contained in a flat Pasteboard Cabinet, price 10s. 6d.
4892. Collection of 54 MINERALS, size half a square inch, in 54 round trays, contained in a flat Pasteboard Cabinet, price 7s. 6d.
4893. Collection of 100 MINERALS, carefully selected for experiments before the Blowpipe, contained in 100 boxes with covers, in a Pasteboard Cabinet price 18s.
4894. Collection of 54 MINERALS for Experiments before the BLOWPIPE, in a Pasteboard Cabinet, price 8s.
4895. Collection of 80 SMALL FRAGMENTS OF MINERALS for Experiments, named and in a box, but not arranged in trays, price 4s.
4896. MOHS'S DEGREES OF HARDNESS, 9 choice specimens of Minerals, in a pasteboard box, price 5s.
4897. VON KOBELL'S DEGREES OF FUSIBILITY of Minerals, 6 choice specimens in pasteboard box, price 4s.
4898. Collection of 50 specimens of MINERALS, of small size, but *all well crystallised* useful to students of crystallography, in a pasteboard box, 8s.
4900. FOSSIL INFUSORIA FOR EXAMINATION BY THE MICROSCOPE. A Cabinet containing twelve specimens of Minerals, Siliceous, Calcareous, Carboniferous, Ferruginous, consisting principally of the skeletons of Infusoria, in 12 bottles in a box, 7s. 6d.
4901. Another Cabinet of FOSSIL INFUSORIA, containing 24 varieties, some of them rare, in bottles, in a box, 18s.

B. COLLECTIONS of MINERALS, NOT IN CABINETS.

4910. Collection of 100 specimens, size 2 square inches, 21s.
4911. Collection of 150 specimens, size 2 square inches, 40s.
4912. Collection of 100 specimens, size 4 square inches, 36s.
4913. Collection of 200 specimens, size 4 square inches, £4 4s.
4914. Collection of 300 specimens, size 4 square inches, £7 7s.
4915. Collection of 500 specimens, size 6 square inches, £20.
4916. Collection of 300 specimens, size 9 square inches, £10 10s.

C. COLLECTIONS of METALLIC ORES, NOT IN CABINETS.

These collections contain specimens of the most important ores from which Metals and Metallic preparations are procured in the Arts.

4924. Collection of 100 specimens, size 4 square inches, £4 4s.
4925. Collection of 200 specimens, size 4 square inches, £10 10s.
4926. Collection of 200 specimens, size 9 square inches, £16 16s.

D. COLLECTIONS of ROCKS, NOT IN CABINETS.

4931. Collection of 100 specimens, size 2 square inches, 21s.
4932. Collection of 150 specimens, size 2 square inches, 40s.
4933. Collection of 100 specimens, size 9 square inches, 31s. 6d.
4934. Collection of 200 specimens, size 9 square inches, £4 4s.
4935. Collection of 500 specimens, size 9 square inches, £14.
4936. Collection of 200 specimens, size 12 square inches, £6 6s.

E. COLLECTIONS of FOSSILS, NOT IN CABINETS.

945. Collection of 100 Fossils, 42s.
 946. Collection of 200 Fossils, £6.
 947. Collection of 500 Fossils, £18 18s.

F. COLLECTIONS of ROCKS and FOSSILS, NOT IN CABINETS.

In these collections, the Rocks are arranged in the order of their superposition in the earth; and are accompanied by the Fossils that chiefly characterise the different strata.

The size of the Rock specimens is 9 square inches.

951. Collection of 150 Rocks and Fossils, £3 13 6
 952. Collection of 200 Rocks and Fossils, 4 14 6
 953. Collection of 300 Rocks and Fossils, 7 0 0
 954. Collection of 500 Rocks and Fossils, 18 0 0
 955. Collection of 800 Rocks and Fossils, 27 0 0

G. RECENT SHELLS.

961. ELEMENTARY COLLECTION of RECENT SHELLS, comprising examples of Marine Shells, Freshwater Shells, and Land Shells, arranged as an introductory study to Fossil Conchology. 150 specimens, *not in a Cabinet*, £4.

H. MIXED COLLECTIONS of ROCKS and MINERALS, NOT IN CABINETS.

962. MINERAL ILLUSTRATIONS OF PHYSICAL GEOGRAPHY, for USE IN SCHOOLS. 100 specimens, size about six square inches, 31s. 6d.
 963. A Glass Case, in which all the specimens may be seen at one view, size 3 feet by 2 feet, 31s. 6d.

This collection is adapted to enable a schoolmaster to explain the nature of different kinds of earth, stones, rocks, &c.; the order in which they occur in the crust of the earth; the simple minerals of which the rocks are composed; the geological strata in which metallic ores are found; the ores of some of the chief metals; the minerals which accompany the ores; the relation of coal, chalk, marble, sulphur, salt, gypsum, marl, pumice, &c., to other minerals and rocks, and to the chemical elements; with many other subjects relating to mineralogy, geology, agricultural chemistry, and physical geography.

964. Mixed Collection of 300 specimens of ROCKS and MINERALS, arranged according to THEIR USES IN THE ARTS; a suitable collection for a Trade School, or Technological Institution, size of the specimens 6 square inches, £7.
 965. Superior Collection of the same description, size of the specimens 9 square inches, £16.
 966. Mixed Collection of 160 specimens, size 4 square inches, including Rocks, Minerals, and Models of Crystals, 40s.
 967. Mixed Collections may be prepared by combination of some of the foregoing collections; for example:—

No. 4910,—100 Minerals	..	£1	1	0	} together £4 4s.
No. 4931,—100 Rocks	..	1	1	0	
No. 4945,—100 Fossils	..	2	2	0	

968. RARE COLLECTION of SPECIMENS, SUITABLE FOR A CHEMIST or METALLURGIST, containing suites of specimens of Ores of the chief metals, such as Silver, Copper, Lead, Iron, Manganese, &c.; with a general collection of earthy Minerals, many specimens of finely crystallised and some of rare minerals. It includes also fine and large specimens of some of the leading Rocks. The collection extends to about a THOUSAND SPECIMENS. Price £50.

MINERALS FOR ANALYSIS AND FOR TECHNOLOGICAL USES.

PRICE PER AVOIRDUPOIS POUND.

	s.	d.		s.	d.
Alum Shale, massive	—	6	Kaolin	1	6
„ Effloresced	—	9	„ ground	—	4
Amber	3	—	Lead Ores :—		
Antimony Sulphide	1	3	Carbonate	1	3
Anthracite	—	4	Molybdate	10	6
Arsenic, Native	4	—	Phosphate, <i>green</i>	1	9
Arsenical Iron	—	6	Selenide, <i>per oz.</i> , 10s.		
Asbestos, long fibrous	2	—	Sulphide, Galena	1	—
Asphaltum	—	3	Lithium Ores :—		
Barium Carbonate	1	—	Lepidolite	1	6
„ Sulphate	—	2	Lithia Mica	—	9
Beryll	2	6	Petalite	4	—
Cadmium Blende	5	—	Spodumene	4	—
Calcium Minerals :—			Magnesite	—	8
Carbonate, Calc spar	—	8	Manganese Ores :—		
„ Carrara Marble	—	6	Pyrolusite	1	—
„ Mountain Limestone	—	3	„ ground	—	2
„ Dolomite	—	6	Psilomelane	—	6
„ Arragonite	1	3	Marle	—	—
„ Iceland spar	4	—	Mica, transparent plates, oz. 4s.		
Fluoride	—	4	Mesotype	2	—
„ Superior	—	8	Nickel Antimonial	5	—
Sulphate, Anhydrite	—	8	„ Arsenical. <i>Kupfernickel</i>	5	—
„ Gypsum, granular	—	6	Oligoclase	1	—
„ „ foliated	—	8	Olivine	2	—
Cerite	4	—	Phosphorite	1	—
Chrome Iron Ore	1	—	Plastic Clay	—	—
Cobalt, Arsenical	6	—	Prehnite	—	—
Copper Ores :—			Rock Crystal	1	—
Copper Pyrites	1	6	Rock Salt, transparent	1	—
Grey Copper. <i>Fahlerz</i>	4	—	Silver, fibrous native, drachm 8d.		
Cryolite	1	3	Steatite	1	—
Feldspar	—	8	Strontium Carbonate	1	—
Graphite, earthy	—	6	„ Sulphate	1	—
„ foliated	3	—	Talc	1	—
Iron Ores :—			Tin Oxide	5	—
Carbonate	—	6	Titanium Ores :—		
„ Clay Ironstone	—	4	Nigrine	4	—
„ Ditto, burnt	—	4	Rutile	5	—
Oxide Hematite	1	6	Titanitic Iron	2	—
„ Red Fibrous	1	6	Tungstenum Ore :—		
„ Brown Hydrate	—	8	Wolfram	1	—
„ Magnetic Ore	—	10	Zinc Ores :—		
„ Specular Ore	1	6	Silicate, <i>Galmei</i>	—	—
„ Loadstone	3	—	Red Oxide	1	—
Sulphide. Pyrites	—	6	Sulphide, <i>Blend</i>	—	—

CRYSTALLOGRAPHY.

81. A set of 120 MODELS OF CRYSTALS, as described in J. J. Griffin's System of Crystallography. See page 442.

These Models represent the most important Natural Crystals, both of simple and complicated forms. Their Size is from 2 to 4 inches in diameter. The Material of which they are formed is Cream Coloured Biscuit Porcelain, which presents the following advantages:—The Models are much stronger than those made of paper. Their edges are sufficiently sharp, and their planes sufficiently even, to permit very good approximate measurements to be taken by means of the common goniometer. They can be written upon, either with a black lead pencil, the marks from which can be effaced by india rubber; or with common ink, which is easily removable by muriatic acid. Consequently, the names of the Crystals, or their symbols, or the angles across their edges, or the names of the minerals they represent, can be written upon them and removed at pleasure. These properties are not possessed in the same degree by Models made of glass or wood. When dried, they can be cleaned by soap and water. Finally they are cheaper than Models made of any other material.

81. Price of the SET OF 120 MODELS, 40s.

82. SINGLE MODELS OF CRYSTALS, 6d. each

83. Collection of 12 Models of Crystals, to show what is meant by the Six Systems of Crystallisation, 5s.

I. *Octahedral System*:—1. Cube. 2. Octahedron. 3. Dodecahedron. 4. Cube and octahedron. *Pyramidal System*:—5. Pyramid with square base. III. *Rhombic System*:—6. Rhombic prism. 7. Rhombic octahedron. IV. *Hexagonal System*:—8. Hexagonal prism. 9. Ditto with pyramid. 10. Rhombohedron. V. *Oblique Prismatic System*:—11. Oblique Prism. VI. *Doubly Oblique Prismatic System*:—12. Doubly oblique prism.

84. Collection of SIXTY MODELS, arranged according to any specified system, 21s.

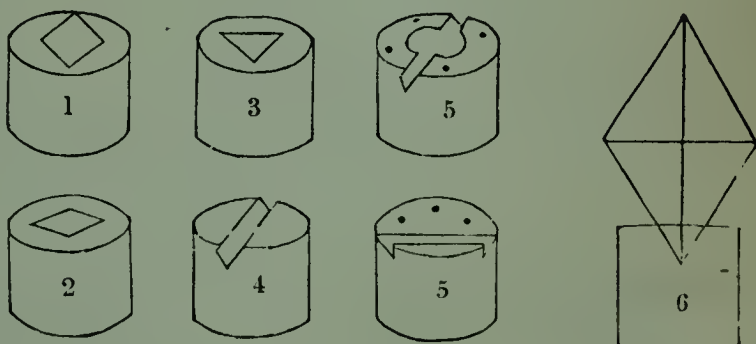
85. Haüy's Primitive Forms of Crystals, a set of 23 Models, 10s.

86. GRIFFIN'S *System of Crystallography* (see page 442), contains very copious Tables of reference to works on Crystallography and Mineralogy, which give figures or descriptions of the crystals represented by each Model. It also contains lists of all the Minerals which have been found in the shape of each model, or in a shape nearly related to it. But every Model in this collection is not merely described in that work—it is made the subject of numerous mathematical problems, and the relation of the Models to Crystallised Minerals is illustrated in the most ample and practical manner. The Models will be found alike useful to private Students and to Teachers.

88. SUPPORTS FOR MODELS OF CRYSTALS:

These supports are intended to hold Crystals in a proper position for Crystallographic examination as represented by No. 6. They are useful for the purpose of exhibiting the Models in a museum, or when a series of Crystals is to be placed before a Crystallographer for study. It is extremely convenient when a suite of Crystals, whether belonging to one system or to one mineral, are to be examined, to have the means of placing the whole in a proper position for examination, without yet to have the hands at liberty to attend to pen or book.

89. The Supports, Nos. 1 to 4, Fig. 4988, are made of Pale Blue Biscuit Porcelain; No. 5, is made of Cedar, price 6d. each.

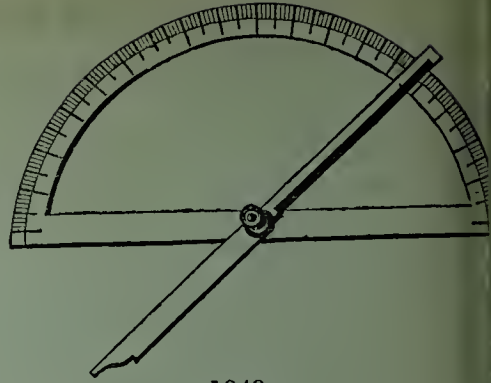


4988.

90. An assortment of twenty Supports for Models of Crystals, 8s.

No. 1 supports all kinds of square based pyramids; No. 2 supports pyramids that have a rhombic base; No. 3 supports rhombohedrons and six-sided pyramids; No. 4 supports all Crystals with symmetrical summits; No. 5 (cedar) with the aid of brass pins, supports such crystals as have unsymmetrical summits, and are not adapted to the porcelain supports. No. 6 represents the manner in which the Crystals are supported.

4991. GONIOMETER for measuring the angles of MODELS of CRYSTALS, &c. where approximate results only are required. A cheap instrument for the student in Crystallography, 7s. 6d.
4992. UPRIGHT GLASS CASE to hold 120 Models of Crystals, 31s. 6d.
4993. Collection of Models of Crystals, cut in wood, 114 specimens, £3 10s.
4994. Collection of 37 Models of Crystals cut in wood, with Optical Axes, in a box, 52s. 6d.



1949.

Pure Chemical Tests,

AND OTHER PREPARATIONS FOR EXPERIMENTS OF
DEMONSTRATION OR RESEARCH.

Avoirdupois Weight :—1 lb. = 16 oz. = 256 dr. = 7000 grains.
1 oz. = 16 dr. = 437½ grains.
1 dr. = 27½ grains.
Imperial Measure :—1 gallon = 4 quarts = 8 pints = 160 fluid ounces.
1 gallon = 10 pounds of water = 10 decigallons.

QUANTITIES UNDER HALF A POUND ARE CHARGED AT THE PRICE PER OUNCE.

The Prices of Chemicals are subject to frequent variation.

MINERAL ACIDS PACKED FOR TRAVELLING.

Corrosive and Combustible Chemicals cannot be packed with Apparatus or other goods for travel, because it is necessary to "Declare" them when delivered to a Railway carrier, or sent on ship-board. They must therefore be put into a separate Package. The safest plan to pack the Mineral Acids is in stoppered green glass bottles, standing upright in strong wooden cases, with wooden divisions between the bottles, and the spaces filled with straw, the cases being made to hold either four or six bottles.

EXPENSE OF CASES AND PACKING MATERIALS.

For 4 pint bottles, 2s. 6d.		For 6 pint bottles, 3s.
For 4 quart bottles, 3s.		For 6 quart bottles, 4s.
For 4 half-gallon bottles, 4s.		For 6 half-gallon bottles, 5s.

COST AND CONTENTS OF THE BOTTLES OF ACID.

The Price includes both Acid and Bottle.

PINT BOTTLES.

						s.	d.
Sulphuric Acid, pure, sp. gr. 1·845	..	..	..	..	2½ lb.	3	—
Hydrochloric Acid, pure, sp. gr. 1·120	..	..	..	..	1½ lb.	1	3
Nitric Acid, pure, sp. gr. 1·180	..	..	..	..	1¾ lb.	2	3
Sulphuric Acid, commercial, sp. gr. 1·845	..	..	..	..	2½ lb.	1	—
Hydrochloric Acid, commercial, sp. gr. 1·155	..	..	..	..	1½ lb.	—	9
Nitric Acid, commercial, sp. gr. 1·360	..	..	..	..	1¾ lb.	1	8
Ammonia, commercial, sp. gr. 0·880	..	..	..	..	1¼ lb.	1	5
Nitric Acid, commercial, fuming, sp. gr. 1·520	..	..	..	..	1½ lb.	5	—
Nitric Acid, pure, sp. gr. 1·380	..	..	..	..	2 lb.	3	6

K K K

MINERAL ACIDS PACKED FOR TRAVELLING, *continued.*QUART BOTTLES (*Corbyn's*).

1	Sulphuric Acid, pure, sp. gr. 1·845	..	..	..	..	5	lb.	5	5
2	Hydrochloric Acid, pure, sp. gr. 1·120	..	..	..	..	3	lb.	2	2
3	Nitric Acid, pure, sp. gr. 1·180	..	..	..	..	3½	lb.	4	4
4	Sulphuric Acid, commercial, sp. gr. 1·845	..	..	..	..	5	lb.	1	1
5	Hydrochloric Acid, commercial, sp. gr. 1·155	..	..	..	..	3	lb.	1	1
6	Nitric Acid, commercial, sp. gr. 1·360	..	..	..	..	3½	lb.	3	3
7	Ammonia, commercial, sp. gr. 0·88	..	..	..	..	2½	lb.	2	2
8	Nitric Acid, commercial, fuming, sp. gr. 1·520	..	..	..	..	3	lb.	9	9
9	Nitric Acid, pure, sp. gr. 1·380	..	..	..	..	4	lb.	6	6

HALF-GALLON BOTTLES (*Winchester's*).

1	Sulphuric Acid, pure, sp. gr. 1·845	..	..	..	..	10	lb.	10	10
2	Hydrochloric Acid, pure, sp. gr. 1·120	..	..	..	..	6	lb.	3	3
3	Nitric Acid, pure, sp. gr. 1·180	..	..	..	..	7	lb.	7	7
4	Sulphuric Acid, commercial, sp. gr. 1·845	..	..	..	..	10	lb.	2	2
5	Hydrochloric Acid, commercial, sp. gr. 1·155	..	..	..	..	6	lb.	1	1
6	Nitric Acid, commercial, sp. gr. 1·360	..	..	..	..	7	lb.	5	5
7	Ammonia, commercial, sp. gr. 0·88	..	..	..	..	5	lb.	4	4
8	Nitric Acid, commercial, fuming, sp. gr. 1·520	..	..	..	..	6	lb.	19	19
9	Nitric Acid, pure, sp. gr. 1·380	..	..	..	..	8	lb.	12	12

	Ounce.	Pound.		Ounce.	Pound.
	s. d.	s. d.		s. d.	s. d.
Acid Acetic, sp. gr. 1·044	— 1	1 —	Acid Nitric, coml. sp. gr. 1·36	—	—
— Acetic, sp. gr. 1·07 cryst.	— 5	5 —	— — pure, sp. gr. 1·18	—	1
— Arsenic, pure	— 4	3 6	— — pure, sp. gr. 1·38	—	1
— — coml.	— 2	2 —	— — coml. fuming, sp.		
— Arsenious, pure	— 2	2 —	gr. 1·48		2
— Benzoic, cryst.	1 6	16 —	— — coml. fuming, sp.		
— Boracic, cryst.	— 3	2 6	gr. 1·52		3
— — fused	— 6	6 —	— Oxalic, coml. cryst.	— 2	1
— Butyric	2 6		— — pure, cryst.	— 3	3
— Carbazotic	2 —		— Phosphoric, glacial	1 —	10
— Carboic, pure, cryst.	— 10	10 —	— Pyrogallie	5 —	
— Chromic, cryst.	1 4	16 —	— Succinic, pure, cryst.	3 —	
— Citric, pure, cryst.	— 5	5 —	— Sulphuric, coml. sp. gr.		
— — coml. cryst.	— 4	3 6	1·845		—
— Formic, solution	— 3	3 —	— — pure, sp. gr.		
— Gallic, pure, cryst.	1 6	18 —	1·845		1
— — coml.	1 2	14 —	— — Nordhausen,		
— Hydrochloric, sp. gr.			fuming		2
1·155 coml.		— 2	— Sulphurous, sol. P.B.		—
— — pure, sp. gr. 1·120		— 6	— Tannic	1 —	10
— Hydrofluoric in gutta			— Tartaric, coml. cryst.	— 3	2
percha bottles :—			— — pure, cryst.	— 5	4
1 oz. 10d. ½ lb. 2s. 6d.			— Tungstic, pure	1 6	
2 oz. 1s. 2d. 1 lb. 3s. 6d.			— Uric	3 —	
4 oz. 1s. 8d.			— Valerianic	3 —	
— Hydrofluosilicic	— 2	2 —	Alcohol, absolute, sp. gr.		
— Hydrosulphuric		2 —	·795	— 10	9
— Molybdic, pure	2 —		— sp. gr. ·805	— 7	6

	Ounce.		Pound.			Ounce.		Pound.	
	s.	d.	s.	d.		s.	d.	s.	d.
alcohol 60° O.P., sp. gr. 84	—	4	4	—	Arsenic, Iodide, pure	5	—		
Methylated	—	2	2	—	— Red Sulphide, Realgar	—	2	2	—
mond Meal			1	—	— Yellow Sulphide, Or-				
um, coml. cryst.	—	1	—	3	pimate	—	2	2	—
pure, cryst.	—	2	1	6	— White Oxide	—	2	2	—
Chrome	—	6	6	—	Asbestos, best white, in				
Iron	—	6	6	—	long loose fibres				
Ammonia	—	2	1	8	(10 lbs. at 1s. 6d. lb.)	—	3	2	—
uminium, metal, in bar	7	6			Barium Acetate, pure, cryst.	—	8	8	—
Sheet and Wire	10	6			— Bromide	3	—		
Thin Leaf, per book of					— Carbonate, Native			1	—
21 leaves, 1s. 6d.					— — coml. precip.	—	2	1	6
Chloride, cryst.	—	9			— — precip. purifi.	—	4	3	6
Oxide; pure Alumina	—	7	6	6	— — pure precip.	—	6	6	—
Sulphate, coml.	—	2	2	—	— Caustic Anhydrous	—	8	7	6
umber	—	4	4	—	— — Hydrate, pure,				
umber and Chloroform					cryst.	—	4	4	—
Varnish	1	—	12	—	— Chloride, coml. cryst.	—	1	1	—
monium, Benzoate	2	6			— — pure, cryst.	—	2	1	6
Bichromate	1	9			— Iodide	3	—		
Bisulphite	2	—			— Nitrate, coml. cryst.	—	1	1	—
Bromide, pure	2	6			— — pure, cryst.	—	2	2	—
Carbonate, coml. purif.	—	1	1	—	— Sulphate, native ground			—	3
— pure	—	2	2	—	— — — cryst.			—	2
Caustic, sp. gr. 88 (120°)			—	9	— Sulphide	—	3	2	6
— sp. gr. 96 (40°)			—	4	Bees' Wax			2	6
Chloride, coml.	—	1	1	—	Benzoic Acid, cryst.	1	6	16	—
— pure	—	2	1	6	Benzole, pure			3	6
Fluoride, pure	3	6			— rough			1	6
Iodide, pure	2	—			Benzole (Crystal) Varnish			5	—
Molybdate, cryst.	2	3			Bismuth, metallic	1	6		
Nitrate, pure, cryst.	—	3	3	—	— Nitrate, pure, cryst.				
Oxalate, pure, cryst.	—	5	5	—	— Subnitrate, pure precip.	1	6		
Phosphate, pure	—	5	5	—	Bleaching Powder	—	1	—	4
Soda-Phosphate, pure,	—	6	6	—	Bone Ash for Cupellation			—	6
Succinate, pure, cryst.	3	6	—	—	— per cwt. 40s.				
Sulphate, pure, cryst.	—	2	2	—	Boracic Acid, pure cryst.	—	3	2	6
Sulphide, solution	—	2	1	4	Borax. See Sodium Borate				
Sulphocyanide	2	—			Boron, per grain, 1s. 6d.				
niline, solution	—	9	8	—	— cryst. per grain, 2s.				
Sulphate, solution	1	6	18	—	British Gum (Dextrine)	—	1	1	—
imal Charcoal, pure	—	5	5	—	Bromides, various.				
Bone Black			1	—	— Ammonium	2	6		
ntichlor	—	2	1	—	— Barium	3	—		
ntimony, Metallic, coml.	—	2	1	3	— Cadmium	2	6		
Chloride, sol. coml.			—	8	— Calcium	3	—		
Sulphide, Native	—	1	—	6	— Chlorine	2	6		
rgol, Red	—	2	1	—	— Iodine	2	6		
White	—	2	1	9	— Iron	2	6		
rsenic, Metallic, coml.	—	4	4	—	— Lime	1	3		
Iodide, coml.	2	—			— Lithium	12	6		

	Ounce.		Pound.			Ounce.		Pound.	
	s.	d.	s.	d.		s.	d.	s.	d.
Bromides, Magnesium	2	6			Cobalt, Acetate	4	—		
— Potassium	2	6			— Carbonate	4	—		
— Sodium	2	—			— Chloride, pure	3	—		
— Zinc	3	—			— Metallic, coml.	4	—		
Bromine, pure	2	6			— Nitrate, pure, cryst.	3	—		
Butyric Acid	2	6			— Peroxide, pure	4	—		
Cadmium, Metallic, pure	1	—			Cochineal	—	6		
— Bromide, pure	2	6			Copper, Metallic, turnings	—	2	2	—
— Carbonate, pure	2	—			— — pure electro-				
— Chloride, pure	2	—			typed in foil	—	4	4	—
— Iodide, pure	2	—			— — in fine flat-				
— Nitrate, pure	2	—			tened wire	—	7	6	—
— Oxide, pure	3	—			— — pure, granu-				
— Sulphate, pure	1	3			lated	—	5	4	—
— Sulphide	3	—			— — in gauge 100				
Calcium Bromide	3	—			to the inch,				
— Carbonate, pure precip.	—	2	2	—	per square				
— — calc spar	—	1	—	8	foot, 10s. 6d.				
— — Iceland spar	—	4	4	—	— Acetate, pure, cryst.	—	5	5	—
— Chloride, pure cryst.	—	2	1	6	— Ammon. Sulph. cryst.	—	5	5	—
— — coml. in lumps					— Carbonate, pure	—	5	5	—
dried			—	2	— Chloride, pure, cryst.	—	5	5	—
— — fused			—	6	— Iodide	1	9		
— Fluoride; Fluorspar	—	1	—	4	— Nitrate, pure, cryst.	—	3	2	—
— Iodide	3	—			— Oxide, black, coml.	—	4	3	—
— Nitrate, pure, cryst.	—	5	5	—	— — — pure	—	8	7	—
— Phosphate, precip. P.B.	—	3	2	6	— — — dense	—	9	8	—
— Phosphide, bottle 1oz.	1	6			— Sulphate, coml. cryst.	—	1	—	—
— Sulphate, pure, precip.	—	3	2	6	— — pure, cryst.	—	2	1	—
— — pure, cryst.	—	6			— Tartrate, pure	—	6		
— Sulphide	—	4	3	6	Cotton Wool, finest				
Camphor	—	3	3	—	Crystal Varnish for Pho-				
Canada Balsam	—	4	3	—	tography			5	—
Caoutchouc, Liquid, 1 lb.			3	6	Dextrine, British Gum			1	—
Carbazotic Acid, cryst.	2	—			Dutch Gold, book of 25				
Carbon Sulphide	—	2	1	3	leaves, per dozen, 2s.				
Cerium Nitrate	4	—			Ether, Sulphuric, sp. gr.				
— Oxalate	3	—			.735 P.B.	—	7	6	—
— Oxide	4	—			— — anhydrous, sp.				
Charcoal, Wood, in sticks			—	2	gr. .725	—	8	7	—
— in fine powder			—	6	— — methylated, sp.				
— Animal, Bone Black			1	—	gr. .73	—	3	2	—
— — pure	—	5	5	—	Fireclay, ground, per				
Chromic Acid, pure, cryst.	1	4	16	—	cwt. 10s.				
Citric Acid, coml. cryst.	—	4	3	6	Flux for Silicates, Fre-				
— — pure, cryst.	—	5	5	—	senius's	—	5	5	—
Chloroform, pure			9	—	Flux, Black	—	3		
— Methylated			6	—	Fluorspar	—	1	—	—
Chloride of Lime	—	1	—	4	Fusible Metal				
Chlorine, Bromide	2	6			Gall Nuts, in powder	—	3	2	—
— solution in Water			—	8	Glycerine, coml.			1	—

	Ounce. s. d.	Pound. s. d.		Ounce. s. d.	Pound. s. d.
lycerine, pure		4 —	Lead Oxide:—Litharge	— 2	1 —
old, Chloride, pure			— Red Oxide	— 1	— 6
cryst.	73 —		— Tartrate	— 6	6 —
— in bottles of			Lime, Bromide	1 3	
15 grains,			— Chloride	— 1	— 4
2s. 9d.			— Salts, <i>see</i> Calcium		
— in bottles of			Liquor Potassæ, sp. gr.		
30 grains,			1.058 °P.B.		— 6
5s. 3d.			— — sp. gr. 1.385		1 3
old Leaf, book of 25			— Soda, sp. gr. 1.047 °P.B.		— 4
leaves 1s. 6d.			— — sp. gr. 1.385		— 6
Grape Sugar	— 2	1 —	Lithium, salts, pure:		
Hydrochloric Acid	} See page 434		— Bromide dr. 1s. 12	6	
Hydrofluoric Acid			— Carbonate dr. 10d. 10	—	
Hydrosulphuric Acid			— Chloride dr. 10d. 10	—	
Indigo	— 8	8 —	— Sulphate cryst. dr. 8d.	8 —	
— Sulphate	— 2	1 6	Litmus, superior	— 3	2 6
Iodine, re-sublimed	1 6		— Tincture, neutral	— 3	3 —
— Bromide	2 6		Lycopodium	— 6	5 6
Iron, metallic, thin wire,			Magnesium Metallic:—		
per hank 6d.			— flat-band dr. 1s. 6d.	16 —	
— Bromide	2 6		— wire dr. 1s. 6d.	16 —	
— Iodide	1 3		— Bromide	2 6	
— Ferric Chloride, subl.	1 —	10 6	— Carbonate, pure precip.	— 2	1 —
— — — cryst.	— 4	4 6	— Chloride, pure	— 4	3 6
— — Sulphate, pure	— 3	2 6	— Iodide	2 3	
— Ferrous Chloride	— 2	1 6	— Nitrate, coml.	— 4	4 —
— — Sulphate purifi.	— 1	— 6	— Oxide, calcined, pure	— 4	4 —
— — pure, cryst.	— 1	1 —	— Sulphate, pure cryst.	— 1	— 5
— — granul. <i>Otto</i>	— 2	2 —	Manganese, Chloride, pure	— 6	5 6
— Red Oxide, coml.	— 1	1 —	— Peroxide native, ground		— 2½
— Sulphide, fused, in			— — in coarse lumps		— 2½
lumps for HS gas	— 1	— 6	— — crystallized	— 2	1 —
— Mohr's Double Salts:—			— Sulphate pure	— 5	5 —
— Amm. Ferrous Sulphate	— 4	3 6	Mercury, Metallic	— 4	3 3
— Amm. Ferric Sulphate	— 5	4 —	— Cyanide	1 6	
— Ferric Chloride, cryst.	— 8	7 —	— Iodide, yellow	2 —	
Kaolin		— 3	— — red	2 —	
Lead, Acetate, coml. cryst.	— 1	1 —	— Perchloride	— 5	
— — pure, cryst.	— 2	1 9	— Protochloride	— 6	
— Subacetate, sol. P.B.	— 2	1 6	— Pernitrate	— 9	
— Carbonate, pure precip.	— 3	3 —	— Protonitrate	— 6	
— — purified	— 2	1 6	— Red Oxide	— 6	
— Chromate, pure fused	— 7	7 —	— Sulphide	— 6	
— — pure precip.	— 4	4 —	— Sulphocyanide		
— Iodide	1 6		Metallic precipitants, box 1s.		
— Metallic, pure, in foil	— 2	1 —	Microcosmic Salt, pure	— 6	6 —
— — powder for			Molybdic Acid	2 —	
Cupellation	— 2	1 8	Naphtha for burning, 7s.		
— Nitrate, coml. cryst.	— 2	1 3	to 10s. per gallon.		
— — pure, cryst.	— 3	2 6	— for Potassium	— 7	6 6

	Ounce. s. d.	Pound. s. d.		Ounce. s. d.	Pound. s. d.
Nickel, Metallic, coml.	1 —		Potassium, Ferrocyanide		
— Chloride, pure	3 6		coml. cryst.	— 2	2
— Nitrate, pure cryst.	2 6		— — pure cryst.	— 5	5
— Peroxide, pure	5 —		— Fluoride	1 —	
— Sulphate, pure cryst.	2 6		— Hydrate purified in		
Palladium, metallic			sticks	— 4	3
— Chloride			— — pure by Alco-		
— Sodium Chloride			hol, in sticks	— 8	8
Paraffine	— 3	3 —	— — sol. See Liq.		
Phosphoric Acid <i>glacial</i>	1 —	10 6	Potassæ.		
Phosphorized Ether	1 —		— Iodide, pure, cryst.	1 6	
Phosphorus	— 6	3 6	— Nitrate, coml. cryst.	— 1	—
— Amorphous	1 —	10 —	— — pure cryst.	— 2	1
Plaster of Paris		— 3	— — pure in powder	— 2	1
Platinised Silversheet for			— Nitrite	1 —	9
Galvanic Batteries	12 —		— Oxalate, pure, cryst.	— 8	8
Platinum Metal Wire or			— — coml. cryst.	— 4	4
foil	33 —		— — Quadroxalate	— 2	2
— Bichloride, cryst	24 —		— Permanganate, fused	— 5	5
Plumbago, very fine	— 2	2 —	— — pure, cryst.	2 —	
Potassium, Metallic	12 —		— Silicate Basic, coml.	— 2	1
— — bottle of 30			— Sulphate, pure, cryst.	— 2	1
grains, 2s.			— Sulphide, coml.	— 2	1
— Acetate, pure cryst.	— 6	5 6	— Sulphocyanide	— 9	
— Antimoniate (Soda test)	— 10	10 —	— Tartrate, pure cryst.	— 4	4
— Bicarbonate, pure cryst.	— 2	2 —	— Tungstate	1 —	
— Binoxalate, coml. cryst.	— 3	2 6	Pyrogallic Acid	5 —	
— — pure cryst.	— 7	7 —	Quinine Sulphate, 1oz.		
— Bisulphate	— 2	1 6	bottle	8 6	
— Bitartrate, coml. cryst.	— 3	2 6	Resin, best amber		—
— — pure cryst.	— 4	3 6	Rouge, finely prepared	1 —	
— Bromide, pure cryst.	2 6		Selenium, per grain, 2d.		
— Carbazotate	3 6		dr. 4s.		
— Carbonate, coml.	— 1	1 —	Silica, pure precip.	1 6	
— — partially purifi.	— 4	3 6	— finely pulverised Quartz	— 1	—
— — pure	— 6	6 —	Silver Acetate, pure cryst.	9 —	
— Chlorate, cryst.	— 2	2 —	— Carbonate	9 —	
— Chloride, pure cryst.	— 2	2 —	— Chloride	9 —	
— Chromate, Red, coml.			— Cyanide	9 —	
cryst.	— 2	1 6	— Iodide	8 —	
— — pure cryst.	— 3	3 —	— Metallic, foil, sheet,		
— — pure fused	— 6	5 6	or wire	10 6	
— Chromate, Yellow, pure			— — Leaf in books		
cryst.	— 4	3 6	each 1s. 3d.		
— Cyanide, fused (Lie-			— Nitrate, cryst.	4 —	
big's) best	— 7	7 —	— Oxide, pure	9 —	
— — Second quality	— 4	3 6	Soap Test, Clark's, pint		
— — pure cryst.	2 —		bottle 4s.		
— Ferridcyanide, coml.			Sodium, Metallic	2 6	
cryst.	— 4	4 —	— — bottle of 100		
— — pure cryst.	1 —	10 6	grains 1s.		

	Ounce.		Pound.			Ounce.		Pound.	
	s.	d.	s.	d.		s.	d.	s.	d.
Sodium, Acetate, pure cryst.	2		1	3	Sulphur, Iodide	1	3		
— Ammon. Phosphate					Sulphuretted Hydrogen <i>sol.</i>			2	—
— cryst.	—	6	6	—	Sulphide of Carbon	—	2	1	3
— Arseniate, pure	—	6	6	—	Tannin	1	—	10	—
— Arsenite, pure	—	5	4	6	Thallium, metallic, per				
— Bicarbonate, pure cryst.	—	2	1	6	grain, 2d.				
— Borate, pure cryst.	—	2	1	6	— Salts of, per grain 2d.				
— fused	—	8	7	6	Tin, metallic, granulated	—	3	2	8
— Bromide, pure cryst.	2	—			— grain tin	—	3	2	6
— Carbonate, coml. cryst.	—	1	—	6	— foil	—	3	3	—
— coml. in powder			—	6	— Bichloride	2	—		
— pure cryst.	—	1	1	—	— solution	—	2	1	6
— pure anhydrous	—	3	2	6	— Protochloride cryst.	—	3	2	6
— Chloride, pure cryst.	—	2	1	6	— Peroxide	—	4	4	—
— Rock Salt					Tungstic Acid, pure	1	6		
transp.	—	2	1	—	Turmeric	—	2	1	6
— Fluoride	—	8	7	—	Turpentine, Spirit of				
— Hydrate, coml. in					Uranium, Acetate, cryst.	4	—		
blocks	—	2	1	—	— Nitrate, cryst.	3	—		
— partially puri-					— Black Oxide	5	—		
fied in sticks	—	4	3	6	— Yellow Oxide	3	—		
— pure (by alco-					Urea	6	3		
hol) in sticks	—	6	5	—	— Nitrate	6	3		
— sol. See Liq.					Vanadium, per grain 1s. 6d.				
Sodæ					Varnish Amber	1	—	12	—
— Iodide, pure	2	—			— Jet, per bottle 9d.				
— Nitrate, pure cryst.	—	1	1	—	Wax, white	—	5	4	6
— Nitro-Prusside	6	—			Water, Distilled, per				
— Phosphate, pure cryst.	—	2	1	6	gallon 1s.				
— Silicate, in lumps, com.					Zinc, Metallic, in blocks				
— Succinate, pure cryst.	2	6			of about 28lb each			—	4
— Sulphate, pure cryst.	—	1	—	4	— granulated			—	8
— Sulphite (Antichlor.)	—	2	1	—	— in fine punch-				
— Bisulphite <i>solution</i>	—	3	2	6	ings			—	5
— Hyposulphite, pure					— in sheets for				
cryst.	—	1	—	8	Batteries			—	6
— Sulphide, cryst.	—	4	3	6	— in thin foil	—	5	4	—
— Tungstate, coml.	—	1	—	9	— free from Ar-				
— pure	—	2	1	6	senic in thin				
Soda-Lime			3	—	rods	—	3	2	—
Starch			—	8	— Bromide	3	—		
Strontium Carbonate pure	—	4	3	—	— Carbonate	—	4	3	—
— Chloride, coml.	—	2	1	3	— Chloride, pure cryst.	—	3	3	—
— pure	—	3	3	—	— pure in sticks	—	4	4	—
— Nitrate, coml. dry	—	2	1	6	— Ammon.-Chloride	—	4	4	—
— pure cryst.	—	2	1	6	— Cyanide	1	6		
Succinic Acid, pure cryst.	3	—			— Iodide	2	—		
Sugar of Milk	—	2	2	—	— Nitrate, pure	—	5	5	—
Sulphur, roll	—	1	—	2	— Sulphate, coml.			—	4
— sublimed	—	1	—	4	— pure cryst.	—	1	1	—
— precipitated	—	2	1	—	— White Oxide, pure	—	4	3	6

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PART II. APPLICATION OF CRYSTALLOGRAPHY TO MINERALOGY:—1. Rose's Tabular Arrangement of known Crystallised Minerals, according to Six Systems of Crystallisation. 2. Catalogue of Crystallised Minerals, showing the Combinations that occur in Nature. 3. Systematic arrangement of the Crystals found in the Mineral Kingdom, with a List of the Minerals common to each Crystal, with an explanation of the Mineralogical Characters employed to discriminate the Minerals that Crystallise in the same Form. 4. Descriptive Catalogue of a Series of 120 Models of Crystals employed to illustrate this system of Crystallography.

MODELS OF CRYSTALS: a Series of 120. Price, 42s. See page 431.

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